DRIN CORDA

Enabling
Transboundary Cooperation
& Integrated Water Resources Management
in the extended DRIN RIVER BASIN

Lake Ohrid Watershed Management Plan

www.drincorda.org

The Coordinated Action for the implementation of the Memorandum of Understanding for the management of the Drin basin (Drin CORDA) is supported by the GEF Drin Project. Thus, the latter constitutes an institutional project implemented by the United Nations Development Programme (UNDP) and executed by the Global Water Partnership (GWP) through GWP-Mediterranean (GWP-Med), in cooperation with the United Nations Economic Commission for Europe (UNECE). The Drin Core Group (DCG), being the multilateral body responsible for the implementation of the Memorandum of Understanding serves as the Steering Committee of the Project. GWP-Med serves as the Secretariat of the DCG.

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Lake Ohrid Watershed Management Plan

Phase 5 – Lake Ohrid Watershed Management Plan

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Description	Final Issue
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Lake Ohrid Watershed Management Plan
Phase 5 – Lake Ohrid Watershed Management Plan

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ABBREVIATIONS AND ACRONYMS

AL	Albania
AMBU	Albanian Water Resource Management Agency
AWB	Artificial Water Body
BOD	Biological oxygen demand
CPA	Cumulative Precipitation Anomalies
CPE	Communal Public Enterprise
DCG	Drin Core Group
DPSIR	Driver-Pressure-State-Impact-Response
DRB	Drin River Basin
DW	Department of Waters
EPA	Environment Protection Agency
EQR	Ecological Quality Ratio
EQS	Environmental quality standard
ERC	Energy Regulatory Commission
ES	Ecosystem services
EU	European Union
EWG	Expert Working Group
FGM	Focus Group Meeting
GAP	Good agriculture practices
GEF	Global Environment Facility
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GWP-Med	Global Water Partnership Mediterranean
ha	Hectare
HBI	Hydro-Biological Institute
HMWB	Heavily Modified Water Bodies
IBNET	International Benchmarking Network
IED	Industrial Emission Directive
IPPC	Integrated Pollution Prevention and Control
IRBM	Integrated River Basin Management
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
km	Kilometer
KTM	Key Type Measure
LOW	Lake Ohrid Watershed
LOWMP	Lake Ohrid Watershed Management Plan
LUC	Land use class
MAFWE	Ministry of Agriculture, Forestry and Water Economy (North Macedonia)
masl	Meters above sea level
MARD	Ministry of Agriculture and Rural Development (Albania)
MKD	North Macedonia
MoTE	Ministry of Tourism and Environment (Albania)
MoEPP	Ministry of Environment and Physical Planning
MoU	Memorandum of Understanding
MS	Measuring (gauging) station
NAPA	National Agency for Protected Areas
O&M	Operation and maintenance
PCU	Project Coordination Unit
PE	Population Equivalents

PoM	Programme of Measures
PP	Polluter pays
RBC	River Basin Councils
RBMC	River Basin Management Council
RBMP	River Basin Management Plan
RBSP	River Basin Specific Pollutants
SAP	Strategic Action Programme
SCI	State Communal Inspectorate
SFI	Shorezone Functionality Index
SHPP	Small Hydro Power Plant
SWB	Surface Water Bodies
SWMI	Significant Water Management Issues
TDA	Transboundary Diagnostic Analysis
TEV	Total Economic Value
ToR	Terms of Reference
TSI	Trophic State Index
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UWWTD	Urban Waste Water Treatment Directive
WB	Water Body
WFD	Water Framework Directive
WM	Waste management
WRA	Water Regulatory Authority
WUA	Water User Association
WWM	Wastewater management
WWTP	Wastewater Treatment Plant
W&WW	Water supply and wastewater management

1 INTRODUCTION

Rina Consulting, in association with PointPro Consulting, has been appointed by the Global Water Partnership Mediterranean (GWP-Med) to:

- ✓ carry out the Watershed Management Plan (WMP) for the Ohrid Lake divided between the southwestern part of North Macedonia and eastern part of Albania (Task I); and
- ✓ test and establish an approach (in the form of Terms of Reference (ToR) for the extended Drin Basin) for the preparation of transboundary management plans in the rivers and lakes of the Drin basin and to develop the ToR for the development of the Extended Drin Basin Management Plan (Task II).

This document represents the Final Lake Ohrid Watershed Management Plan and is the seventh Report in a series of 9 Intermediate Reports, respectively to be prepared from 1 to 7 under Project Task I and from 8 to 9 under Project Task II:

- ✓ Intermediate Report 1: Phase 1 - Inception Report;
- ✓ Intermediate Report 2: Phase 2 - Data Collection and Analysis Progress Report;
- ✓ Intermediate Report 3: Phase 3 - Summary of River Basin Characteristics Progress Report;
- ✓ Intermediate Report 4: Phase 4 - Programme of Measures Progress Report;
- ✓ Intermediate Report 5: Phase 4: Long – Term Basin - Scale Monitoring Programme Progress Report;
- ✓ Intermediate Report 6: Phase 5 - Draft Lake Ohrid Watershed Management Plan;
- ✓ **Intermediate Report 7: Phase 5 - Final Lake Ohrid Watershed Management Plan;**
- ✓ Intermediate Report 8: Generic ToR Template for Transboundary Basin Management Plan, and
- ✓ Intermediate Report 9: ToR for the Drin River Basin Management Plan.

1.1 PROJECT BACKGROUND

Coordinated action at the Drin Basin level has been absent until the development of the Shared Vision for the sustainable management of the Drin Basin and the signing of a related Memorandum of Understanding (Tirana, 25 November 2011) by the Ministers of the water and environment management competent ministries of the Drin Riparians i.e. Albania, North Macedonia, Greece, Kosovo and Montenegro. This was the outcome of the Drin Dialogue coordinated by the Global Water Partnership Mediterranean (GWP-Med) and United Nations Economic Commission for Europe (UNECE).

The main objective of the Drin Memorandum of Understanding (MoU) is the attainment of the Shared Vision: “Promote joint action for the coordinated integrated management of the shared water resources in the Drin Basin, as a means to safeguard and restore, to the extent possible, the ecosystems and the services they provide, and to promote sustainable development across the Drin Basin”.

The ultimate goal of the work in the Drin Basin is to reach a point in the future where the scale of management lifts from single water bodies to the hydrological interconnected system of the Drin Basin, eventually leading from the sharing of waters among Riparians and conflicting uses, to the sharing of benefits among stakeholders.

A process called the “Drin CORDA”, Drin Coordinated Action for the implementation of the Drin MoU, was put in place after the signing of the latter. Following the provisions of the MoU an institutional structure was established in 2012. It includes:

- ✓ the Meeting of the Parties;
- ✓ the Drin Core Group (DCG). This body is given the mandate to coordinate actions for the implementation of the MoU; and
- ✓ three Expert Working Groups (EWG) to assist the DCG in its work:
  - Water Framework Directive (WFD) implementation EWG,
  - monitoring and information exchange EWG, and
  - biodiversity and ecosystem EWG.

The DCG Secretariat provides technical and administrative support to the DCG; Global Water Partnership – Mediterranean (GWP-Med) serves by appointment of the Parties through the MoU as the Secretariat.

An Action Plan was prepared to operationalize the Drin CORDA. This has been subject to updates and amendments in accordance with the decisions of the Meeting of the Parties to the Drin MoU and the DCG. The DCG and its Secretariat guides the implementation of the action plan while its implementation is currently being supported by the Global Environment Facility (GEF).

GEF supported Project "Enabling transboundary cooperation and integrated water resources management in the extended Drin River Basin" (GEF Drin Project) is aligned in content, aims and objectives with the Action Plan and the activities under the Drin CORDA.

The objective of the project is to promote joint management of the shared water resources of the transboundary Drin River Basin, including coordination mechanisms among the various sub-basin joint commissions and committees. Albania, North Macedonia and Montenegro are the Project beneficiaries. The GEF Drin project is structured around five components:

- ✓ component 1: consolidating a common knowledge base;
- ✓ component 2: building the foundation for multi-country cooperation;
- ✓ component 3: institutional strengthening for Integrated River Basin Management (IRBM);
- ✓ component 4: demonstration of technologies and practices for the Integrated Water Resources Management (IWRM) and ecosystem management, and
- ✓ component 5: stakeholder involvement, gender mainstreaming and communication strategies.

The Project is implemented by the United Nations Development Programme (UNDP) and executed by the Global Water Partnership (GWP) through GWP-Mediterranean (GWP-Med) in cooperation with the UNECE. GWP-Med is responsible for the realization of the Project. The DCG is the Steering Committee (SC) of the Project. It is managed by a Project Coordination Unit (PCU), based in Tirana, Albania; staff is stationed also in Podgorica, Ohrid, Pristina, and Athens. The duration of the Project is four years.

1.2 SCOPE OF WORK

The general Scope of Work (SoW) of the present assignment is to:

- ✓ carry out the Lake Ohrid Watershed Management Plan (LOWMP) – Task I; and
- ✓ test and establish an approach (in the form of ToR for the extended Drin Basin) for the preparation of transboundary management plans in the rivers and lakes of the Drin basin and to develop the ToR for the development of the Extended Drin Basin Management Plan (Task II).

Preparation of the LOWMP is one of the pilot projects adopted in the frame of Component 4. The work is carried out in accordance with the EU-WFD, as well as with international obligations of the countries, the developmental plans of the national governments, local authorities as well as the management plans of protected areas, forests, fisheries etc. in Ohrid sub-basin as well as in the area that extends beyond the Ohrid sub-basin, downstream in the Black Drin Basin. The work also takes into consideration all water needs, both consumptive and non-consumptive e.g. for the generation of hydroelectricity by the electricity companies as per existing plans; the relevant international agreements between the two countries regarding the management of basins and allocation of water. The development of the LOWMP is based on:

- ✓ regional perspectives within the Ohrid basin in each one of the two countries for economic development, and disparities in poverty and well-being across the basin areas and between rural and urban areas;
- ✓ inter-sectorial perspectives in terms of economic value of water used in the different sectors;
- ✓ the need to analyze gender difference in access to, control of and use of water resources and plan accordingly; and
- ✓ the need to coordinate between the two littoral countries as well in each one of the countries, and sequence interventions, among others in the form of investments, to ensure sustainable and economical efficient water resources management in the basin.

Additional input for the preparation of the LOWMP comes from:

- ✓ work that has been done in the two littoral countries for the implementation of the legislation that transposes the EU-WFD as well as the European Union (EU) Directives that relate to the management of water resources, basins, aquifers and ecosystems;
- ✓ the outcomes of the:
  - Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) supported "Conservation and Sustainable Use of Biodiversity" program on the three lakes Skadar, Ohrid and Prespa,
  - GIZ supported "Climate Change Adaptation Program in Western Balkans" that includes activities also in the Drin Basin.
- ✓ the outcomes of the (on-going) Albanian Drin Management Plan preparation project;
- ✓ existing studies and information available to the institutions and research institutes in the littoral countries;
- ✓ strategic documents (sectoral, of local governments etc.) in the two littoral countries regarding the development of the area in the Lake Ohrid Watershed (LOW), including spatial plans;

- ✓ any investigation undertaken by the authorities of any of the two countries towards the designation of Lake Ohrid as a "Sensitive Area" in line with EU Urban Waste Water Treatment Directive(UWWTD);
- ✓ decision of adjoining countries for the designation of sensitive areas or catchments of sensitive areas, and
- ✓ experiences from the UNDP/GEF projects in the Danube River Basin to prepare EU WFD Characterization Reports and River Basin Management Plans to guide the approach adopted.

The process for the development of the LOWMP is highly participatory in accordance to the related guidance documents of the EU WFD and the best practices in this regard, and in line with the UNECE Water Convention and the ESPOO Convention.

The groups of stakeholders include national and local institutions and authorities in the field of the management of environment, water, natural resources, land, local authorities, developmental ministries, NGOs, private sector, academia etc.

1.3 REPORT ORGANIZATION

This document represents the sixth Progress Report related to the implementation of this assignment. Based on the above, the Report is organized as follows:

- ✓ Section 1 (present section) - Introduction – includes the Project background and the scope of work;
- ✓ Section 2 presents the description of the Lake Ohrid watershed;
- ✓ Section 3 provides an overview of the institutional setup for water resources management in the LOW; a list of stakeholders in the LOW is also provided;
- ✓ Section 4 includes assessment of drivers and pressures on water quality and quantity in the LOW;
- ✓ Section 5 includes the assessed ecological and chemical status of water bodies in the LOW;
- ✓ Section 6 presents the environmental objectives of the LOWMP;
- ✓ Section 7 represents the plan's Programme of Measures;
- ✓ Section 8 includes economic analysis; and
- ✓ Section 9 includes information on public participation events that took place during preparation of the LOWMP.

Supporting information is provided in Supplements and Appendixes. Graphical presentation of key data is presented in Thematic GIS-based Maps. Technical information is presented in metric units and the costs are in US$ or Euro.

2 DESCRIPTION OF THE LAKE OHRID WATERSHED

2.1 NATURAL CONDITIONS

2.1.1 Topography and Geology

With a maximum depth of 290 meters and average depth of 155 meters, straddled in the mountainous region between the southwest part of North Macedonia and the eastern part of Albania, Lake Ohrid is one of the oldest and deepest lakes in Europe. The lake is located at an altitude of 693 masl and has an area of 358 km^2. The hydrological regime of the lake is dominated by inflow of water from the nearby Lake Prespa via karstic aquifers, while the outflow occurs through the Black Drin river in the town of Struga.

The Lake Ohrid watershed (LOW) is part of the extended transboundary Drin River Basin (DRB), located in the South-Western part of the Balkan Peninsula and shared between Albania, Kosovo, North Macedonia and Montenegro (Fig. 2.1). The DRB comprises seven sub-basins: Lake Prespa, Lake Ohrid, Black Drin River, White Drin River, Drin River, Lake Skadar/Shkodër and Buna/Bojana River.

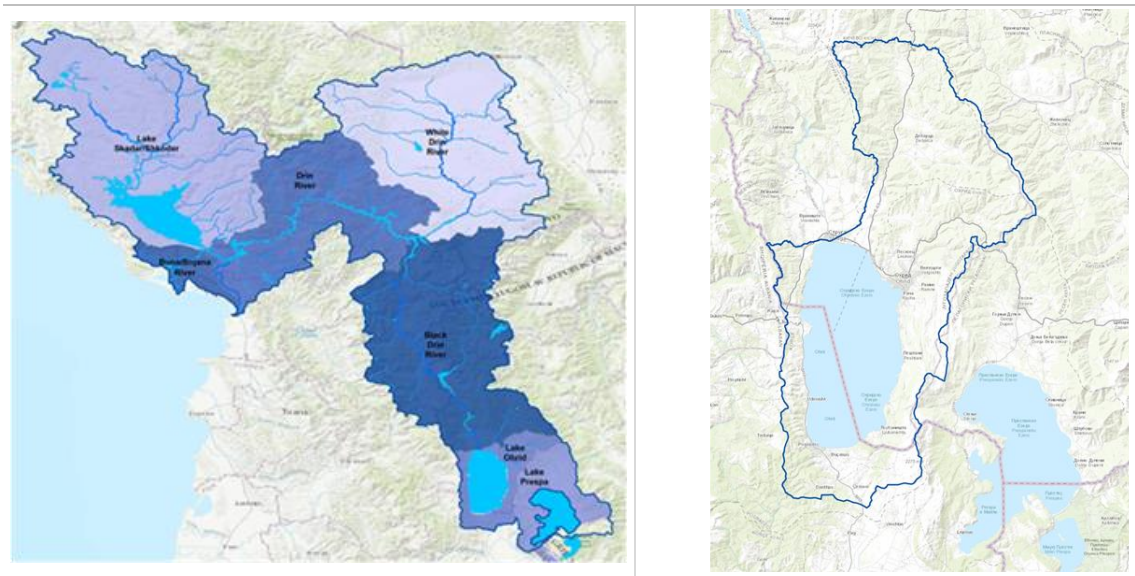

Figure 2.1. The Extended Drin River Basin and Lake Ohrid Watershed

With an estimated age of 2 to 5 million years and maximum water depth of 290m Lake Ohrid is a deep, calcium bicarbonate-dominated, oligotrophic lake that represents a unique aquatic ecosystem. Of the 1,200 registered animal species in the lake, 212 are considered endemic. The importance of the lake is further emphasized with its declaration as a World Heritage Site by UNESCO in 1979 (North Macedonia part) and 2019 (Albania part). With all its amenities and values the lake also represents the most important tourist center in North Macedonia. Key characteristics of the LOW are presented in Fig 2.2 below.

2.1.2 Climate, Hydrology and Hydrography

In general, the local climate conditions in the LOW are categorized as Mediterranean with continental influences. According to Watzin et al. (2003) the local climate is influenced by the proximity to the Adriatic Sea, by the surrounding mountains, and by the thermal capacity of Lake Ohrid.

The mean annual temperature recorded in the Ohrid region averages at 11.5 °C; average temperatures range from 21ºC during summer to 1.8ºC during winter (Fig 2.3). The temperature of Lake Ohrid's pelagic water (below 150 m depth, year-round) ranges from 6ºC to 24–27ºC at the surface during summer.

The morphology of the catchment also affects the wind regime, with Northerly winds prevailing during winter and southerly and southeasterly winds during spring and summer. Average speed of the wind in the Lake Ohrid region is relatively low at 1.8 m/sec.

Indicator	
Watershed area (km^2)	1,404.9
Lake total area (km^2)	357.9
Watershed/Lake area ratio	3.9
Maximum elevation (masl)	2,271
Average watershed elevation (masl)	1,139
Minimum elevation (Lake Ohrid, masl)	693.1
Lake water level control (Yes/No)	Yes
Average water level change (m)	0.8
Average lake depth (m)	155
Maximum lake depth (m)	293
Lake volume (km^3)	58.6
Dynamic ratio (km/m)	0.6
Retention time (Years)	70- 80
Shoreline length (km)	87.5
Trophic classification	Oligotrophic

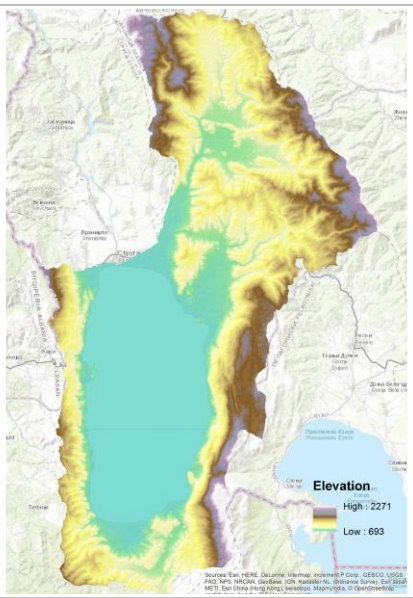

Figure 2.2: Key Characteristics of the Lake Ohrid Watershed

Precipitation averages around 750 mm annually and is at a minimum during summer.

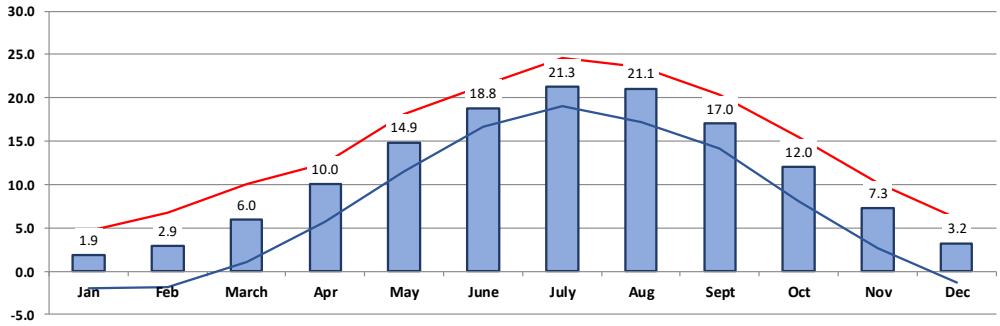

Figure 2.3: LOW: Average (Av. Min and Av. Max) Temperature (MS Ohrid, 1961 – 2016)

On annual basis, precipitation and lake water-level oscillation reach their peak values (maximum and minimum) in different seasons. Maximum precipitation occurs in the form of snowfall in November/ December, when the lake's water levels are at their lowest. The snow remains throughout the winter at high altitudes (above 1,000–1,500 masl.), but begins melting and entering the lake in March/April which then reaches its maximum water level in May/June (Fig. 2.5).

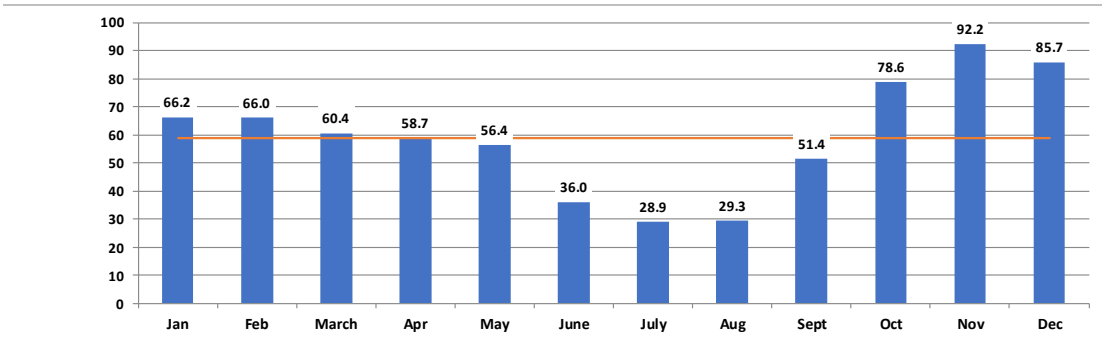

Figure 2.4: LOW: Average Monthly Precipitation (MS Ohrid, 1961 – 2016)

In order to assess the influence of precipitation on fluctuations of the Lake Ohrid water level, the Cumulative Precipitation Anomalies (CPA) have been analyzed. CPA directly measure the shortage of rainfall by calculating the difference between the observation and the long-term climatological record. The CPA values are calculated based on:

- ✓ differences between monthly precipitation average values for the period 1965-2015; and
- ✓ those anomalies are cumulated. The CPA graph determines the positive and negative phases in precipitation variability.

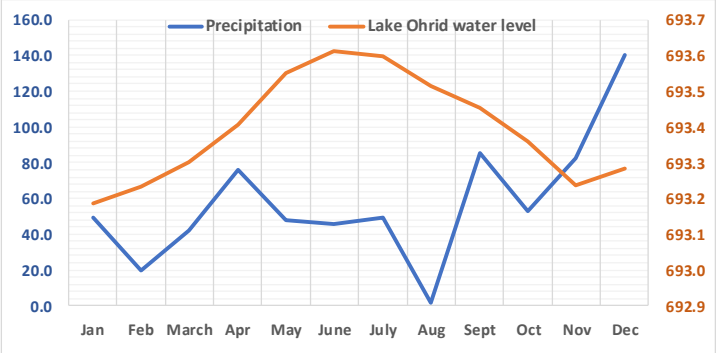

Figure 2.5: Annual Precipitation and Lake Water Level Changes (MS Ohrid, 2014)

The drought event registered for the analyzed period can be seen in the negative slopes of the graph, starting from 1986/7 until 1995/6.

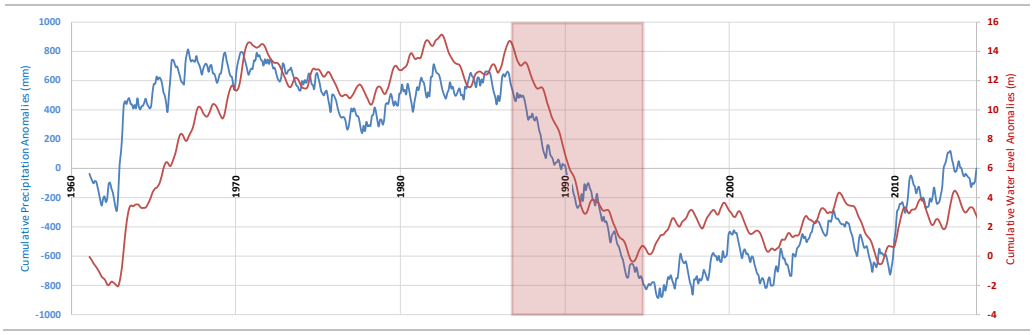

Figure 2.6: LOW: Precipitation and Lake Water Level, Monthly Cumulative Anomalies

The hypothesis that the water from Prespa Lake is seeping into the karst massif of the Galichica and Suva Gora mountains and draining into Ohrid Lake (LOW) was first published by Cvijić (1906). The validity of the hypothesis was proven with isotope-based tests (Anovski et al. 1997, 2001; Eftimi and Zoto 1997). Much of the karstic type of aquifers are found in the triennial limestones of Galichica and Jablanica, which drain through numerous springs into Lake Ohrid. Estimates imply that 49% of the inflow from springs into the lake comes from sublacustrine (under water) springs and 51% from surface springs. The most important are: St. Naum (5-10 m^3/sec), Tushemisht (2.5 m3/sec), Biljanini springs (1-2 m3/sec), Bej Bunar (40-100 l/s), and other unknown number of sublacustrine springs.

Besides the springs, important volume of water drains in Lake Ohrid through a number of tributaries, most of which are small creeks that flow only temporarily during snowmelt and heavy rain periods. The main rivers in the LOW, tributaries to Lake Ohrid (Fig. 2.7; Map 1), include: Sateska, Koselska, Shushica and Grashnica river in North Macedonia, as well as Çeravë and Verdovë rivers in Albania. Details regarding the hydrological parameters of these rivers are given further in the document (Section 2.3: Typology and delineation of water bodies).

Two-thirds of the LOW (Lake Ohrid) water outflow passes into the Black Drin River at the town of Struga, flowing Northwards on the way to the estuary in the Adriatic Sea. The remaining one-third of the lake's water is lost through evaporation (Watzin et al. 2002).[1]

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[1] Source: "Shorezone Functionality, Ohrid Lake"; Implementing the EU Water Framework Directive in South-Eastern Europe. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (2017).

Since 1962 the river's outflow has been controlled with a weir, which regulates the water level. According to an agreement between Yugoslavia and Albania in 1962, the maximum water level in Ohrid Lake is not permitted to exceed the value of 693 masl and the minimum water level to fall below 691.65 masl (Watzin et al. 2002)[2]. However, following later developments, i.e. negotiations and agreements between the two countries, since 1979 the minimum water level in Lake Ohrid is set at 693.10 masl (outflow in Black Drin river in Struga) and the maximum 'operational' level at 693.75 masl, resulting in annual fluctuations of the level in the range of 0.65 m. Further, the agreement between the countries stipulates that in the case of extreme events of water inflow into the lake (with probability up to 1%) the set maximum water level of 693.75 can be exceeded, but not surpassing 694.00 masl.

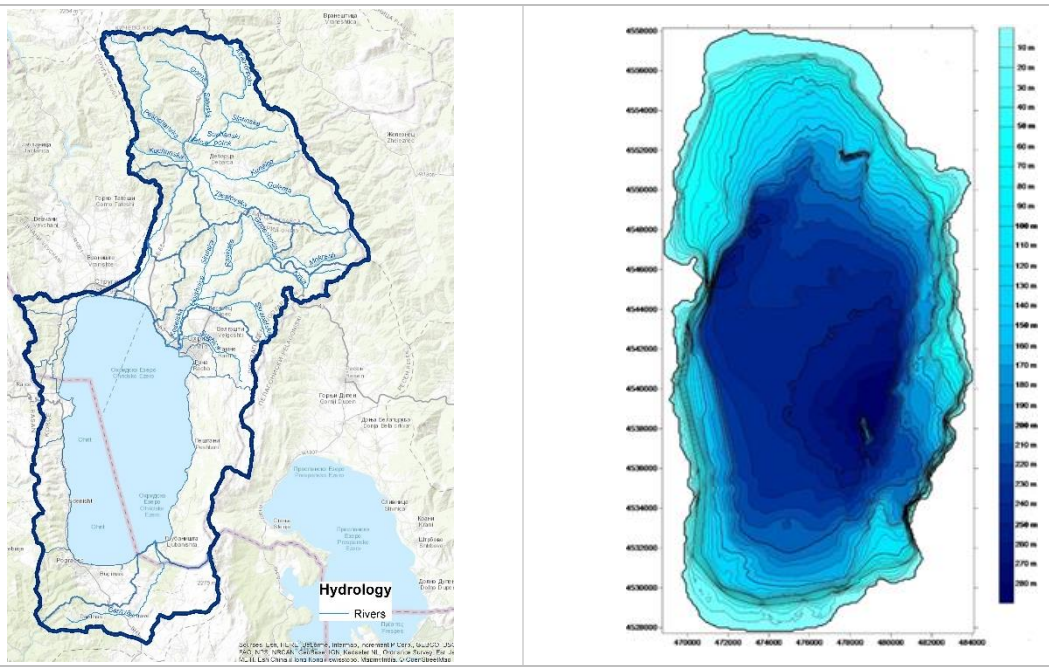

Figure 2.7: LOW: Tributaries and Bathymetric Map of Lake Ohrid

Based on analysis of the recorded water level in Lake Ohrid for the period 1965 – 2016, it is evident that the level of 693.75 masl has been exceeded for a total of 1,970 days, or roughly 10% of the total number of days for the period. Further, the level of 694.00 masl has also been exceeded in 129 days (ratio of 1%). These events, on annual basis, take place during the April – June period. Finally, also the minimum set level of 693.10 masl has not been observed occasionally, that is the actual water level has been lower than the agreed minimum, for a total of 160 days (ratio of 1%) during the drought period 1989 – 1991.

2.1.3 Land Cover

The land cover/land use analysis of the LOW is based on data from the European Environment Agency's CORINE Programme[3] (Fig. 2.8; Map 2; Map 3). A total of 14 land cover classes are analyzed that are included under Programme's Level 2 nomenclature; the area of Lake Ohrid is treated as a separate (one of the 14) land cover category.

The surface area of the LOW is dominated by Forests, Scrub and open spaces, and the surface area of Lake Ohrid, which collectively account for 79% of the total basin area (Fig. 2.8)[4]. Other dominating land cover classes are Arable land and Heterogeneous agricultural areas, which make up 15.6% of the area. Of the remaining 5.3% of land, dominant classes are Urban fabric (2%) and Pastures (1.9%).

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2 Source: "Shorezone Functionality, Ohrid Lake"; Implementing the EU Water Framework Directive in South-Eastern Europe. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (2017).

3 European Environment Agency (EEA), CORINE (Coordination of information on the environment).

4 Data for 2012.

2.1.4 Protected Areas

A total of 9 protected and sensitive areas located in the LOW are identified, that fall into four of the six IUCN[5] categories (Table 2.1; Map 4). The total area of all protected areas equals 661.6 km^2 (47% of the total basin area), of which 273.2 km^2 in Albania and 393.2 km^2 in North Macedonia.

CORINE Land Classes	Area (km2)	% of total
Arable land	43.0	3.06%
Artificial, non-agri. vegetated areas	1.4	0.10%
Forests	457.5	32.58%
Heterogeneous agricultural areas	176.1	12.54%
Industrial, comm. and transport units	2.0	0.14%
Inland waters	2.0	0.14%
Inland wetlands	0.7	0.05%
Mine, dump and construction sites	0.6	0.04%
Open spaces with little or no vegetation	0.4	0.03%
Pastures	26.0	1.85%
Permanent crops	15.1	1.07%
Scrub and/or herbaceous vegetation	294.8	20.99%
Urban fabric	27.6	1.96%
Lake area	357.0	25.43%
Total LOW	**1,404.0**	

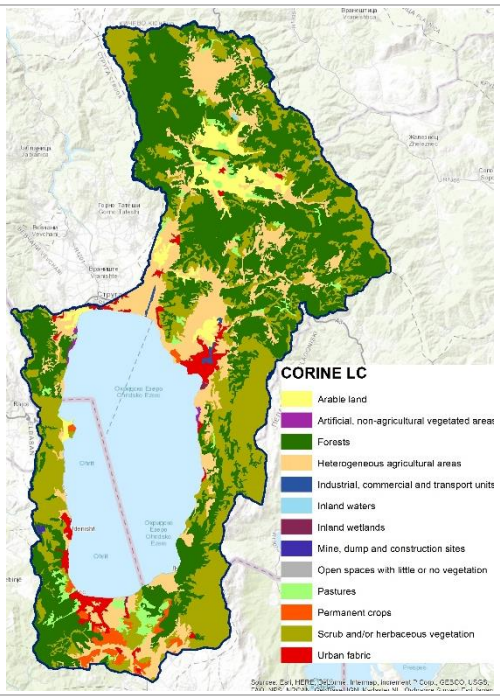

Figure 2.8 LOW: Land cover (CORINE Level 2 LUC)

Annex IV of the WFD specifies five categories of protected areas. Besides the IUCN-areas listed in Table 2.1, to the extent possible also the areas designated for abstraction of water intended for human consumption (captured springs, groundwater/wells and abstractions directly from the lake), the karst springs of Lake Ohrid and fish spawning sites in Lake Ohrid are identified and mapped (Map 4). In addition, although specific bathing areas (Directive 2006/7/EC) are not designated in Albania and North Macedonia, the entire Lake Ohrid is regarded as bathing area. Finally, the remaining two types of protected areas – nutrient sensitive areas and Natura 2000-sites – are not applicable (such areas have not yet been designated) in both Albania and North Macedonia.

Table 2.1: LOW: Protected Areas6

ISO3	Site Name	Year	Designation	IUCN CAT	Area (km^2)
MKD	Galichica	1958	National Park	II	145.9
MKD	Ohridsko Ezero	1977	Designated area not yet reviewed	III	247.4
MKD	Duvalo (Kosel)	1979	Designated area not yet reviewed	III	0.0
MKD	Makedonski dab, s.Trpejca, Ohrid	1967	Designated area not yet reviewed	III	0.0
MKD	Platan s.Kalishte, Struga	1961	Designated area not yet reviewed	III	0.0
MKD	Platan-chinar, Ohrid	1967	Designated area not yet reviewed	III	0.0
ALB	Shebenik-Jabllanice	2008	National Park (category II)	II	0.6
MKD	Platanovi Stebla, Ohrid	1967	Designated area not yet reviewed	III	0.0
ALB	Liqeni I Ulzes	2013	Managed Nature Reserve (category IV IUCN)	IV	272.6
				Total	**666.4**

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[5] IUCN – International Union for Conservation of Nature.

[6] Source: European Environment Agency's (EEA), The European inventory of nationally designated areas holds information about protected areas and the national legislative instruments, which directly or indirectly create protected areas.

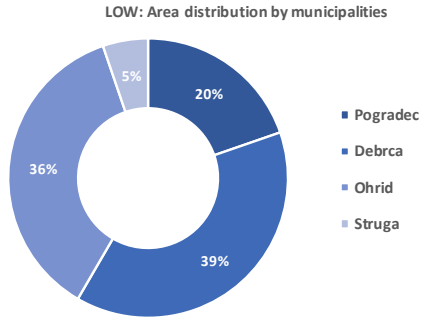
2.2 SOCIO-ECONOMIC CONDITIONS

2.2.1 Administrative Division and Governance

As mentioned before, the transboundary LOW is part of the extended DRB and is shared between Albania (313 km^2 or 22% of the total basin territory) and North Macedonia (1,091 km^2; 78% of the territory).

Administratively, the watershed area falls under four municipalities (local government units), of which Pogradec municipality is in Albania, while Ohrid, Struga and Debrca municipalities are in North Macedonia. The distribution of the LOW territory by the four municipalities is shown on Fig. 2.9. In reference to the administrative division of the basin territory by municipalities, it should be pointed out that only 34% of Pogradec, 98% and 95% of Ohrid and Debrca respectively, and merely 11% of the total area of Struga municipality falls within the LOW.

Following the territorial division of Albania from 2014/15, the Albanian territory of the LOW falls under five Administrative Units: Buçimas, Çeravë, Dardhas, Pogradec and Hudenisht.



Municipality	No of settlements	<500	500 - 1,000	1,000 - 2,000	>2,000
Pogradec	25				
Debrca	30	29	1		
Ohrid	33	23	6	1	3
Struga	6	1	1	2	2
TOTAL in LOW	94	53	8	3	5

Figure 2.9: LOW: Area and Settlements Distribution by Municipalities

The total number of settlements in the basin equals 94, of which 25 (26.6%) in Albania (Pogradec municipality) and 69 (73.4%) in North Macedonia. 53 of the 94 settlements (or 56%) have population of less than 500, and only 5 have population bigger than 2,000 (Fig. 2.9, Map 5)[7]. 58% of the total population in the LOW lives in the three largest cities (municipal administrative centers): Pogradec, Ohrid and Struga.

2.2.2 Demography and Housing

The total population of the LOW equals 132,059 divided nearly equally between female and male population. Of the total, 39% live in Pogradec municipality, 3% in Debrca, 39% in Ohrid and 19% in Struga (Table 2.2, Fig. 2.10 and Appendix A).

Table 2.2: LOW: Population Statistics

Municipality	Female	Male	Total Municipality	Year	% of LOW population	Area (km^2)	Population density (cap/km^2)	% Urban	% Rural
Pogradec	25,341	26,375	51,716	2011	39%	206.2	251	14%	86%
Debrca	2,005	1,989	3,994	2015	3%	405.0	10	0%	100%
Ohrid	26,183	25,668	51,850	2015	39%	381.0	136	75%	25%
Struga	12,285	12,214	24,498	2015	19%	54.8	447	71%	29%
TOTAL in LOW	65,813	66,245	132,059		100%	1,047.0	126	48%	52%

The overall density of the population for the LOW as a whole is 126 persons per square kilometer. However, there are important differences among population densities per municipalities, ranging from 447 cap/km^2 in Struga, 251 cap/km^2 in Pogradec, 136 cap/km^2 in Ohrid, and only 10 cap/km^2 in Debrca.

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[7] Population data for Albania is at a level of Administrative Units. Sources: Albania: Institute of statistics (INSTAT), Republic of Albania; North Macedonia: State Statistical Office, Republic of North Macedonia.

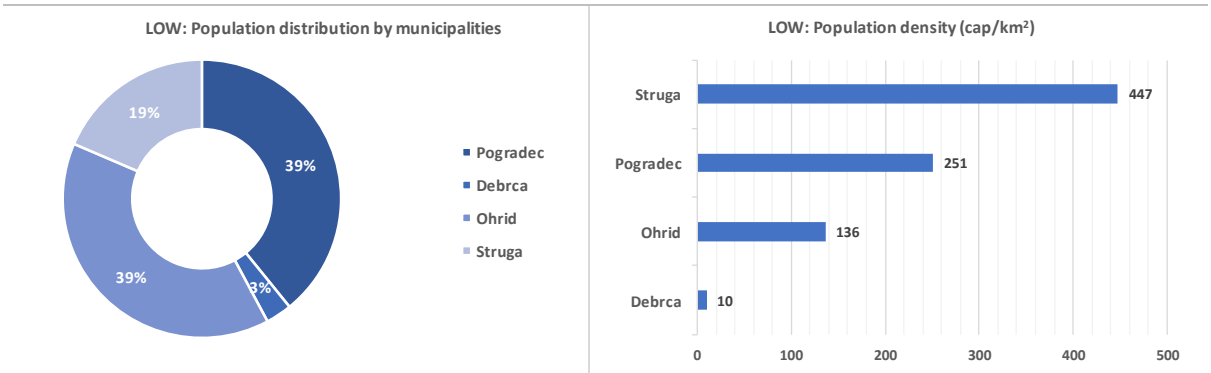

Figure 2.10. LOW: Population Distribution and Density by Municipalities

2.2.3 GDP and Employment

According to national statistics, the GDP per capita in 2018 was $5,239 in Albania and $6,100 in North Macedonia. Statistical data for both countries show relatively steady upward growth in these figures over the last several years.

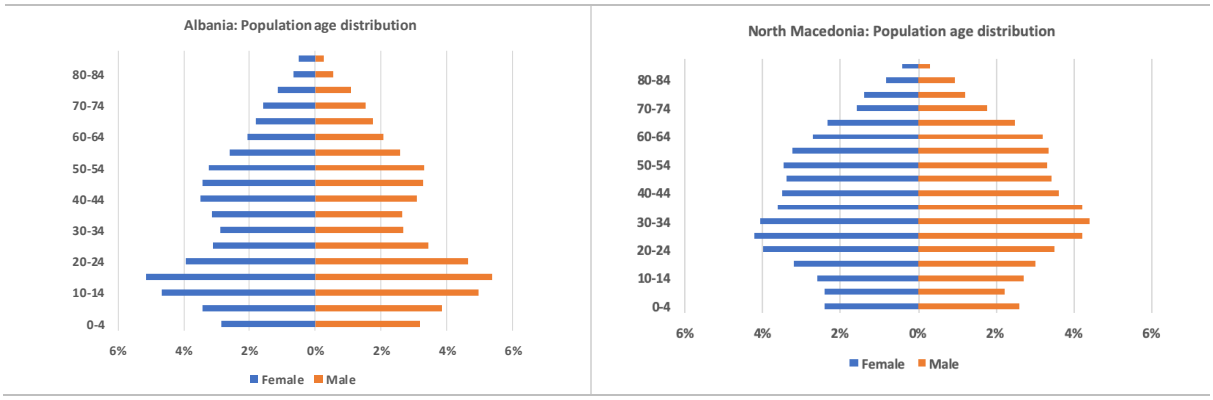

Figure 2.11: LOW: Population Age Structure

As regards employment, statistics are kept differently in each country but it is clear that unemployment and/or underemployment are high in both countries. In Albania, according to data compiled by the Albanian Institute of Statistics, in 2016 the unemployment rate equaled 15.2%; in North Macedonia, according to the State Statistical Office, the same rate equaled 23.7%. The situation is considered even more difficult if market indicators are segregated by gender. Thus, the inactivity rate (proportion of the population that is not in the labor force) in 2015 in Albania equaled 52.7% for female population and 35.7% for male population, whereas in North Macedonia the same rate for the female population equaled 55% and 30.8% for male population.

2.2.4 Tourism and Local Economic Development

Tourism is one of the most important and fastest growing activities/industries worldwide. The tourism industry has a significant direct and indirect impacts on the economies of a number of countries. In 2016 1.23 billion tourists travelled the world, generating income, supporting job creation and boosting development.

As mentioned before, tourism is the key economic activity in both countries around Lake Ohrid. The climate, geography and physical variety of the territory represented by the lake and mountain ranges accompanied by exceptionally rich biodiversity of flora and fauna, as well as by culture monuments and historical sites, make the entire LOW an attractive and highly-valued tourism site. A number of national parks and nature reserves are also located within the basin, offering possibilities for development of various types of tourism and travel experiences. Finally, Lake Ohrid is declared as a World Heritage Site by UNESCO since 1979.

The key types of tourism activities in the LOW are:

- ✓ water/lake-based tourism, which includes various kinds of leisure activities in the form of "beach and sun" tourism;
- ✓ alternative/adventure tourism, which includes all kinds of rural tourism, eco-tourism and nature based activities: paragliding, mountain biking, fishing, trekking, climbing, hiking, study tours, etc., in basin's natural parks;
- ✓ culture and history based tourism, concentrated around various kinds of archeological and spiritual sites in the region; and
- ✓ business and transit tourism, is the last type of tourism present in the LOW, which is by and large related to business trips and associated activities (e.g. meetings, conferences, exhibitions) taking place primarily in the bigger cities (municipal centers).

Table 2.3 provides an overview of registered visitors within the LOW for the 2011 – 2017 period. The number of visitors in the region has increased from nearly 290,000 in 2011 to over 410,000 in 2017, which is a 142% increase, while the number of registered overnights has increased from 1.28 million to nearly 1.44 million over the same period. Further, both the number of foreign and domestic visitors has been constantly increasing, albeit at different rates.

Table 2.3: LOW: Tourism statistics8

Municipality	Administrative Unit	Tourists, domestic and foreign 2011 - 2017							Average
		2011	2012	2013	2014	2015	2016	2017	
Pogradec	Buçimas	51,100	50,000	50,000	50,000	52,500	55,125	57,881	52,372
	Çerravë								
	Dardhas								
	Pogradec								
	Udenisht								
Debrca	N/A								
Ohrid	N/A	178,277	183,335	192,746	197,196	219,944	234,361	275,613	211,639
Struga	N/A	59,079	55,556	59,526	59,171	64,094	74,415	77,238	64,154
TOTAL in LOW		**288,456**	**288,891**	**302,272**	**306,367**	**336,538**	**363,901**	**410,732**	**328,165**

Municipality	Administrative Unit	Overnights, domestic and foreign 2011 - 2017							Average
		2011	2012	2013	2014	2015	2016	2017	
Pogradec	Buçimas	153,300	150,000	150,000	150,000	157,500	165,375	173,644	157,117
	Çerravë								
	Dardhas								
	Pogradec								
	Udenisht								
Debrca	N/A								
Ohrid	N/A	810,795	823,666	796,048	754,048	818,175	830,333	937,041	824,301
Struga	N/A	317,143	295,726	276,920	260,090	300,791	311,624	330,489	298,969
TOTAL in LOW		**1,281,238**	**1,269,392**	**1,222,968**	**1,164,138**	**1,276,466**	**1,307,332**	**1,441,174**	**1,280,387**

The major tourism and recreation facilities in the basin are located around the three municipal centers of Pogradec, Ohrid and Struga, but as well along the eastern shoreline (Ohrid town to the village of Peshtani), south-east part around the villages of Trpejca, Ljubanishta and St. Naum and north-west section from Struga to Kalishta in North Macedonia, and on the stripe from Tushemisht to Pogradec and the Lin peninsula in Albania (Map 6).

Apart from tourism, other dominant local economic activities in the LOW are fishery, agriculture, trade and services, forestry and hunting. Mining, metal fabrication, wood processing, textile fabrication and other light industries are present on the Albanian side of the basin, mainly around the city of Pogradec[9]. On the North Macedonia side the industry sector is centered around construction, textile fabrication, and food processing. The local economy on both sides is dominated by small size enterprises.

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[8] Source: North Macedonia – State Statistical Office; Albania – "Baseline Assessment of the Lake Ohrid region – Albania", Towards Strengthened Governance of the Shared Transboundary Natural and Cultural Heritage of the Lake Ohrid Region, IUCN-ICOMOS (2016). Data for 2011 and 2013 given in the source;

[9] Source: "Baseline Assessment of the Lake Ohrid region – Albania", Towards Strengthened Governance of the Shared Transboundary Natural and Cultural Heritage of the Lake Ohrid Region, IUCN-ICOMOS (2016).

2.2.5 Economic infrastructure

Pogradec is located about 139 km from the capital of Tirana and 40 km from Korça. Pogradec is also the last railway station: Tirana - Durrës - Elbasan - Librazhd - Pogradec and located along SH3 road that passes through Devoll and continues to Greece. The road network connecting Pogradec and the other settlements in the municipality is 140 km. A modern road section Qafe Thane-Lin-Pogradec has been recently reconstructed. Most of the villages in the region can be reached by paved roads, especially along the national highway between Tirana and Korce (south eastern Albania). In the south of the lake there is a paved road connecting Pogradec with the North Macedonia border.

On the North Macedonia side, Ohrid and Struga are roughly 180 km from the capital of Skopje. A new high-way Kichevo-Ohrid is under construction, that will significantly further improve the connection between the region and the capital and other larger cities in the country. A paved road along the entire North Macedonia part of the lake has been constructed since the 1960-ties.

There is also an international airport on the North Macedonia part of the basin – the St. Paul Apostle airport near Ohrid, with capacity of 400,000 passengers and registered average annual number of passengers of over 83,000 for the 2010 – 2016 period. The Ohrid airport is also used for cargo transport.

Overview of the main infrastructure in the LOW is given on Map 7.

2.2.6 Cultural Heritage

Apart from the natural heritage of the Lake Ohrid region, which dates back to the Tertiary period, it has homed humanity for thousands of years as well. Remains of Neolithic settlements have been found around the lake, with further inhabitance by Illyrian and Hellenic tribes confirmed by ancient scripts, the still standing Ancient theatre of Ohrid and the Monumental Tombs of Lower Selca.

As the history of the region developed, so did the appearance and life in the settlements around the lake. The remains of Via Egnatia, the ancient Roman road connecting Rome and Istanbul in near vicinity of the lake are proof of the civilization continuum throughout the era before Christ. Various early roman Basilicas and mosaics, such as the ones in Lin, St. Erasmo and Plaoshnik account for the early adoption of Christianity in the region. The 6-th century paleochristian church of Lin's floor mosaics spreading over 120m^2 are remarkably conserved and have an outstanding artistic value.

As the Slavic tribes began to settle in the region and adopted Christianity, the region became a cradle of Christian theology. Various saints practiced and spread Christianity around the lake, amongst which St. Clement of Ohrid is the most important. Nowadays a newly reconstructed Church sits where St. Clement himself reconstructed an old Church with the purpose of spreading Christianity amongst Slavs. He founded the Ohrid Literacy School, where the Bible was taught in Old Church Slavonic with the use of the Cyrillic script, which he helped develop. His tomb rests in the church to this day.

In the middle ages the region became part of Tsar Samuil's empire, with the city of Ohrid serving as the capital. The fortress built for his needs, with findings of ancient Greek scripts suggesting that it was originally built in the 4-th century B.C., was later used by the Ottoman empire and it sits on the highest point of the city to this day.

On top of a hill in Pogradec there are remains of an Illyrian-Albanian castle in a site that has been populated since the 6-th century B.C. The churches of St. Sophia and Kaneo in the city of Ohrid from the 11th and 13th century respectively, are prime examples of Byzantine architecture that attract plenty of tourists, host cultural events, etc. St John Kaneo's church, sitting on a cliff right above the lake, blends marvelously with the natural setting of the region. The St. Naum monastery from the 16-th century on the other side, too, sits on a plateau right above the lake and has historically welcomed both Christians and Muslims from the region.

Apart from the Byzantine, today's architecture of the area is mostly from the times of the Ottoman Empire. The narrow cobbled streets, numerous mosques and churches, tightly built two to three story buildings throughout the lakeside cities of Ohrid and Pogradec are what gives them such a particular charm.

2.3 TYPOLOGY AND DELINEATION OF WATER BODIES

2.3.1 Surface waters

Lake Ohrid has special physical and biological characteristics compared to other large lakes in Europe. The lake is stratified into two distinct layers, the hydrologically dynamic epilimnion (upper layer) and the more static, voluminous hypolimnion (lower layer).

The WFD System A (Annex II, Section 1.2) was used to for establishing the typology of water bodies in the LOW. Selection of the appropriate methodology A and B depends on the existing data, but some descriptors specifically for system B were considered for refinement of the delineation of Lake Ohrid watershed. For many of the river and lake water bodies in LOW there are no available data according to requirements of System B. Additionally, several other projects performed on Lake Ohrid (GIZ, NIVA) used the same methodology for delineation of the water bodies in the LOW.

Typology of Lake Water Bodies

Lake Ohrid was considered as a single type of water body in previous research projects[9]. Some previous typology and delineations were made on political basis, i.e. using the border line between Albania and North Macedonia. However, such an approach is not appropriate and not applicable since the lake as ecosystem cannot be divided on such criterion that is different (opposite) to WFD recommendations. Such political criteria might be used for delineation of the waterbodies, but not for typology of the lake. During the process of establishing typology and delineation of water bodies, all relevant documents (e.g. the GIZ report and the Draft Drini Management Plan) were consulted.

In general, the WFD does not exclude other elements, such as part of a lake, from being considered as distinct water bodies. For example, if part of a lake is of a different type to the rest of the lake or the pressures categories and intensity differ the lake must be sub-divided into more than one surface water body.

Past and recent investigations of biota from Lake Ohrid show significant difference in species composition between littoral and sublittoral/profundal regions. Also, significant differences in species composition have been observed on different substrates at same depth. For instance, diatoms, macroinvertebrates and macrophytes are different on sandy substrate and hard substrates (stones and rock). According to Cvetkoska et al. substrate and depth have the greatest impact on diatom distribution is the lake. Additionally, at least 182 animal species and more than 200 diatom species are considered as endemic for Lake Ohrid and in many cases have limited distribution, inhabiting particular habitat or locality in the lake. According to Cvetkoska et al. at some localities in the lake such as St. Naum Bay, Trpejca Bay and Kalishta, between 65-80% of the diatom species in the community are endemic for Lake Ohrid. More detailed explanation of Lake Ohrid being a biodiversity hot-spot is given in Supplement IV.

Type-specific biological reference should be established for every type of water body representing the values of the biological quality elements (specified in point 1.1 in WFD Annex V) for that surface water body type at high ecological status as defined in the relevant table in WFD section 1.2 in Annex V. In such case it will be extremely hard to almost impossible to establish type-specific biological reference conditions for Lake Ohrid if it is treated as a single type. In general it is very hard to establish reference conditions for Lake Ohrid because of two reasons:

- ✓ the presence of high percentage of specific (endemic or relict) species; and
- ✓ limited taxonomical, ecological and biogeographical research of biological quality elements (for instance macroinvertebrates).

Some progress on this field has been made in last 10-15 years, suggesting that the number of endemic species is even higher than it was previously known/supposed. However, attempts to find other reference lakes in Montenegro and Albania should be omitted as inappropriate. Lake Ohrid is unique ecosystem in the world and trying to find reference conditions in other lake has no scientific basis. In this moment it is imperative to have detailed taxonomical, distributional and ecological research on biological quality elements made by relevant researchers for all taxonomical groups that will be used as basis for establishing reference conditions.

WFD Guidance Document No. 2 “Identification of Water Bodies” suggests subdivision of lakes on the basis of significant differences in the biological and hydrogeological characteristics.

Based on these criteria and specific geomorphological features of Lake Ohrid, four (4) different types of water bodies have been identified in the lake:

1. the first type is part of the littoral region of 0 to 15 m water depth, characterized by sandy substrate, almost flat bottom and gentle slope where water depth gradually increases;
2. the second type comprises also the littoral region (0 to 15 m water depth), but with rocky bottom and steep slope;
3. the third type is the largest one, comprising the deep part of the lake characterized by clay bottom and more stable physico-chemical conditions (temperature, oxygen, light availability, etc.); and
4. the fourth type includes the spring regions of St. Naum (North Macedonia) and Tushemisht (Albania).

Delineation of Lake Water Bodies

For purposes of the LOWMP a more detailed delineation of the Surface Water Bodies (SWB) is proposed, based on differences in the size (surface area), geology (substrate) altitude, depth and possible risk of failing the environmental quality objectives (Table 2.4). Beside hydromorphological and biological elements, the presence of significant point source pollution from urban, industrial, and other installations and activities, as well as diffuse pollution from agricultural activities, is used as criteria for delineation of water bodies. Such approach is based on information from previously identified pressures on Lake Ohrid and monitoring data from Hidrobiological Institute.

Overall, 8 Lake Water Bodies belong to MSSM type, 4 to MSRM and 1 MMCD. According to hydrological data, maps and field trips, previous research and biological data, in total 13 lake water bodies have been identified (Fig. 2.12; Map 8). Beside water depth, slope, form and shape of bed, substratum composition, also available data for relevant biological elements (diatoms, macrophytes, microinvertebrates and fish) are used for delineation and identification of the water bodies in Lake Ohrid watershed.

Table 2.4: LOW: Typology and Delineation of Lake Water Bodies

No.	Water body type	Water body name	Starting point altitude	Altitude	Surface area of water body (km^2)	Area of WB sub-catchment (km^2)	Size typology	Geology	Geology code	Depth	Code
1	L	L-Radozhda	693.4	M	3.16	6.2	S	Sand	S	M	MSSM
2	L	L-Kalishta	693.4	M	0.8	22.3	S	Sand	S	M	MSSM
3	L	L-Struga-Black Drin	693.4	M	5.25	14.4	S	Sand	S	M	MSSM
4	L	L-Sateska	693.4	M	4.8	32	S	Sand	S	M	MSSM
5	L	L-Koselska	693.4	M	1.8	157	S	Sand	S	M	MSSM
6	L	L- Ohrid bay	693.4	M	1.6	9.85	S	Rock	R	M	MSRM
7	L	L-Velidab	693.4	M	3.1	116	S	Rock	R	M	MSRM
8	L	L-Bay of St. Naum	693.4	M	1.6	91	S	Sand	S	M	MSSM
9	L	L-Tushemisht	693.4	M	0.81		S	Sand	S	M	MSSM
10	L	L-Pogradec	693.4	M	5.8	56.6	S	Sand	S	M	MSSM
11	L	L-Hudenisht	693.4	M	3.4	40.6	S	Rock	R	M	MSRM
12	L	L-Lin	693.4	M	2.24	22.7	S	Rock	R	M	MSRM
13	L	L-Lake Ohrid-Pelagic	693.4	M	322		M	Clay	C	D	MMCD

Typology and Delineation of River Water Bodies

Based on the quantity and quality of the available data, the only possible choice is to use system A for identification and delineation of the river water bodies in the LOW. However, data from GIS digital maps (model) are obtained for the mean water course slope, and these data are used for proper river basin characterization (surface water body delineation and typology).

Based on the WFD requirements, three (3) types of river water bodies have been identified in the LOW (Map 8):

1. HMC – rivers on High altitude with Medium size Catchment area on carbonate background;
2. MSC – rivers on Medium altitude with Small size Catchment area on carbonate background; and
3. MMC – rivers on Medium altitude with Medium size Catchment area on carbonate background.

According to this typology the following subdivision can be made (Table 2.5):

- ✓ one river water body belongs to type 1 HMC (Sateska 1);
- ✓ three river water bodies belong to type 2 MSC (Sateska 2, Koselska 1 and Cerave);
- ✓ two river water bodies belong to type 3 MMC (Koselska 2 and Sushica);
- ✓ one water body is characterized as heavily modified – Sateska 3; and
- ✓ one water body characterized as artificial – Studenchishki kanal.

Table 2.5: LOW: Typology and Delineation of River Water Bodies

No.	Water body Type	Water Body Name	Starting Point Altitude	End Point Altitude	Altitude	Catchment size (km^2)	Size typology	Geology	Combination
1	R	R-Sateska 1	1,273	760	North	345.0	M	C	HMC
2	R	R-Sateska 2	760	709	M	49.0	S	C	MSC
3	HMWB	R-Sateska 3	709	693.4	M	32.0	S	C	MSC
4	R	R-Koselska 1	1,979	877	M	36.0	S	C	MSC
5	R	R-Koselska 2	1,833	693.4	M	157.0	M	C	MMC
6	R	R-Cerave	1,035	695	M	91	S	C	MSC
7	R	R-Sushica	1,220	693.4	M	45	S	C	MMC
8	AWB	Studenchishki kanal	693.5	693.5	M	9.85	S	C	MSC

Typology and Delineation of Heavily Modified and Artificial Water Bodies

According to the WFD, Heavily Modified Water Bodies (HMWB) should be identified and designated where good ecological status is not being achieved because of impacts on the hydromorphological characteristics of a surface water resulting from physical alterations. The identification of HMWB must be based on the designation criteria set out for river water bodies. According to WFD artificial water body represents a body of surface water created by human activity, while HMWB is a body of surface water which as a result of physical alterations by human activity is substantially changed in character. Artificial or heavily modified water bodies are designated if:

- ✓ the changes to the hydromorphological characteristics of that body would have significant adverse effects on the wider environment and water regulation, flood protection, land drainage;
- ✓ the beneficial objectives served by the artificial or modified characteristics of the water body cannot, for reasons of technical feasibility or disproportionate costs, reasonably be achieved by other means, which are a significantly better environmental option; and
- ✓ these conditions are proved in the designation test.

In principle, the boundaries of HMWBs are primarily delineated by the extent of changes to the hydromorphological characteristics that:

- ✓ result from physical alterations by human activity; and
- ✓ prevent the achievement of good ecological status.

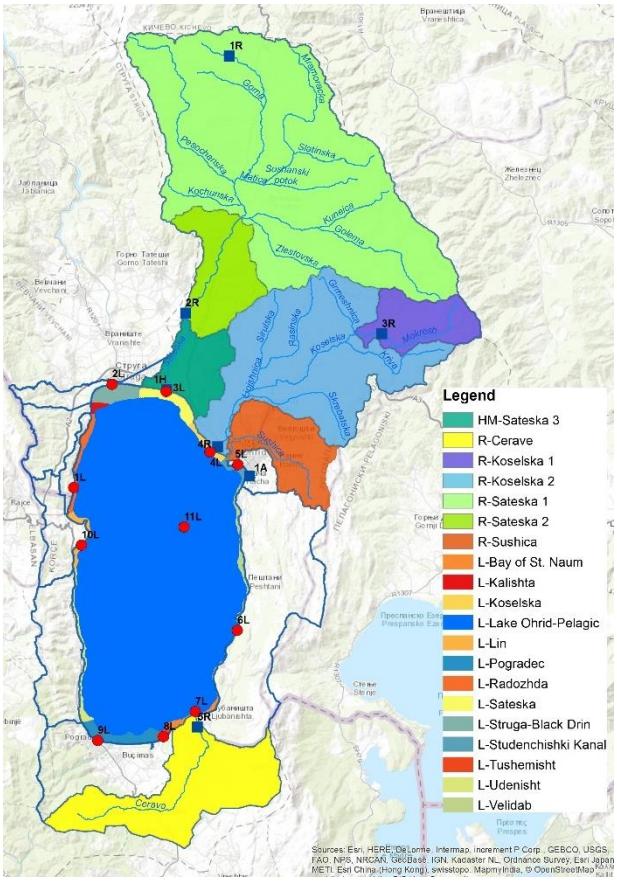

Figure 2.12: LOW: Delineation of Surface Water Bodies

Based on available data one single HMWB has been identified in the LOW – River Sateska 3. This part of the river starts near the village of Volino at altitude of 709 masl. and ends at the inflow into the lake, with total length of 7 km. Regulation (channelization) of the river bed is mainly for prevention of flood of the surrounding agricultural land and settlements.

In the LOW, also one Artificial Water Body (AWB) was identified – channel Studenchista. It is with total length of approximately 700 m located between Ohrid and Racha, and in the past known as Studenchishka River. The Studencishta wetland is located around the channel at an altitude of 694 to 696 masl. (medium height of 695 masl.) between Studencishka Reka (today the Studencishta canal) and the Racha River (North and south) and between the regional road Ohrid-St. Naum and the coast of Ohrid Lake (east and west).

The Studencishta wetland is valorized as a natural phenomenon preserved for millennia and hence it's particular significance for the Ohrid Lake. The wetland, not long ago, was an integral part of the Ohrid Lake. It stretched North and south of Studenchiska Reka (today the Studencishta channel) and with numerous channels it was connected with Lake Ohrid. Any change in the water level of the lake directly influenced the wetland. It was inhabited by various plant and animal species. Many cyprinid (white) fish (especially carp) were spawned in the wetland, and many water birds also nested. Today, wet habitats occupy an area of over 50 ha, while muddy and swampy fields stretch about 25 ha, in the immediate vicinity of the channel. The wet meadows around occupy larger spaces. The southern and eastern parts of the site are converted into cultivated areas, fields, meadows and orchards.

2.3.2 Groundwater

The groundwater body delineation for North Macedonia has been made based on available raster hydrogeological maps in scale 1:200.000 (source: Geological survey of North Macedonia), and the groundwater aquifer has been divided into 5 different types of typology as follows[10]:

- ✓ Type 1 - Aquifer zones with intergranular porosity having high to middle transmissivity and permeability;
- ✓ Type 2 - Aquifer zones with intergranular porosity having low transmissivity and permeability;
- ✓ Type 3 - Aquifer zones with karst-fracture porosity having high transmissity and permeability;
- ✓ Type 4 - Zones with local aquifers with limited extent close to the surface and waterproof at deeper levels practically impermeable; and
- ✓ Type 5 – zones that are neither an aquifer nor a groundwater body.

Following this delineation, there are four groundwater bodies in the LOW:

Table 2.6: LOW: Typology and Delineation of Groundwater Bodies

Groundwater body name	Aquifer Type	Horizon	Description
GWB001_Horz1	1	1	Porous highly productive
GWB002_Horz1	1	1	Porous highly productive
GWB021_Horz2	2	1	Fissure highly productive
GWB022_Horz2	2	1	Fissure highly productive

In addition, referenced publication also specifies a total of 12 transboundary groundwater aquifers, including those shared between Albania and North Macedonia. Fig. 2.13 below and Map 9 represent the groundwater bodies in the LOW based on the “Type1 - Type5” delineation.

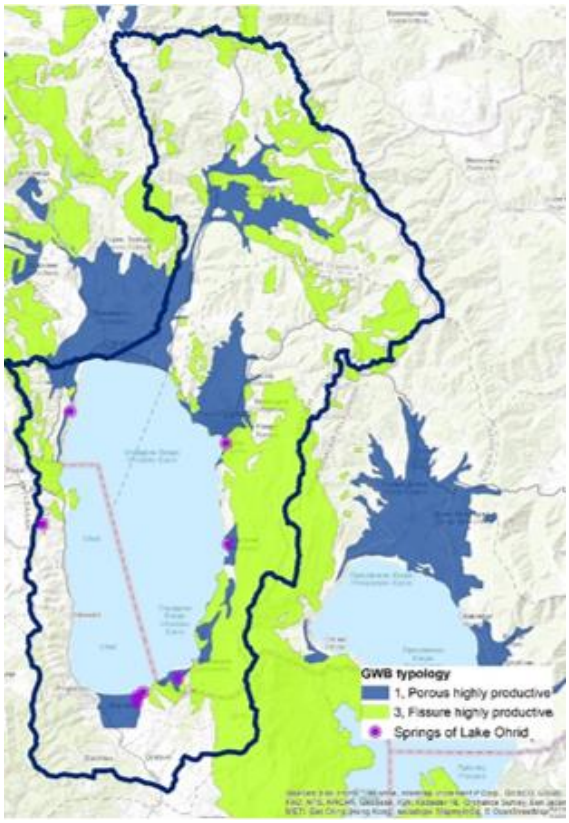

Figure 2.13: LOW: Typology and Delineation of Groundwater Bodies

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[10] Source: “Typologies of Groundwater in Macedonia (FYR)”, Report”; Proj. Ref. EuropeAid/132108/D/SER/MK : Technical Assistance for Strengthening the Institutional Capacities for Approximation and Implementation of Environmental Legislation in the Area of Water Management; Ramboll (2015).

On the other hand, following other authors, groundwater on the territory of North Macedonia is generally prevalent in deposits located in two types of lithological formations: non-bound quartile and neogeneous lithological formations with intergranular porosity (compact type of aquifers – i.e. equivalent to Type 1); and aquifers formed in carbonate rock masses with karst cracks porosity (karst fissure type of aquifers, equivalent to Type 3).

The country is divided into 16 water management areas. The Ohrid-Struga water-management unit covers an area of 1,489 km2 or about 5.8% of the total country area. This area covers the Ohrid-Struga basin, as well as the bordering parts of the mountains Jablanica, Galichica and Karaorman. The compact type of free-level aquifer has been developed in quaternary and Pliocene deposits in valleys with a thickness of 10-40 m, as well as in the alluvium deposits of the Black Drin, Koselska and Sateska River. In the Pliocene sediments in the central part of Struga valley and parts of Ohrid valley a developed type of spring with a pressure level with variable capacity of water bodies is found.

Table 2.7: LOW: Groundwater Reserves represents estimated groundwater reserves in the Ohrid-Struga Water Management District. The total yield of all sources in this water management area is estimated at around 10 m3/sec. The biggest consumers of water in the area are the cities of Ohrid and Struga, which are supplied mainly by purification of the lake water and with underground waters from the karst spring. Ohrid is supplied with purified lake water (250 l/sec), as well as by delimitation of the karst springs Bej Bunar, Biljanini springs, as well as several wells in the karst (spring near locality of Orman - Dolno Lakocherej with a total amount of about 250-300 l/sec groundwater). Struga and the surrounding settlements are supplied by capping of karst springs in Gorna Belica and Shum (280l/sec). There are a number of villages in this area that are not connected to public water supply systems, using mostly own capped karst springs and rarely drilled wells.

Table 2.7: LOW: Groundwater Reserves

Aquifer type	Source of underground water	Estimated groundwater reserves Static (x106m^3) Exploitation (m^3/s)	
Compact	Ohrid-Struga valley (Quaternary)	161	0.5
	Ohrid-Struga valley (Pliocene)	72	
Karstic	Galichica		5.0
	Jablanica		

Much of the karstic type of aquifers are found in the triennial limestones of Galichica and Jablanica, which drain through numerous springs into Lake Ohrid (Map 4). Estimates imply that 49% of the inflow from springs into the lake comes from sublacustrine (under water) springs and 51% from surface springs. The most important are: St. Naum (5-10 m3/sec), Tushemisht (2.5 m3/sec), Biljanini springs (1-2 m3/sec), Bej Bunar (40-100 l/s), and other unknown number of sublacustrine springs.

2.4 LAKE OHRID SHOREZONE FUNCTIONALITY

2.4.1 Overview

Lakes provide a variety of ecosystem services: provisioning (e.g. fresh water, fish), regulating and maintenance (regulation of flows, habitat maintenance, etc.) and cultural (tourism and recreation, aesthetic satisfaction, abiotic characteristics of nature that enable spiritual, symbolic and other interactions). Thus, there are numerous dissimilar interests for the lakes' environment. On the other hand, lakes are affected by a number of pressures coming from the watershed's streams that negatively distresses the trophic-evolutionary processes of their waters.

The riparian zone has an important role in protecting and buffering the degradation of the lake's aquatic ecosystem derived by human activities. Land uses that consist in elimination of riparian vegetation, often cause environmental stresses, increased instances of non-point source pollution, and result in morphologic alterations and habitat destruction[11]. The area around the shores is a transitional zone between the surrounding territory and the lake and guarantees the execution of ecological process needed to protect the lake from the watershed's pollution. Its structure and extension are influenced by the topography, the climate and the soil's geological composition, while its water fluxes, the nutrients and sediment inputs, and the diffusion of animal and plant species are influenced by the lake riparian vegetation.

The shorezone represents the area that includes the littoral (maximum depth of 1 meter) and the riparian zones, which can carry out important ecological functions such as: regulate nutrients inputs, filters runoff and aids sedimentation before the water coming from the watershed enters into the lake, provides habitat for aquatic and terrestrial animals, offering food, shade, shelters, areas for hunting and breeding, protects the shoreline from erosion**,** favoring bank stabilization. "Lake Shorezone Functionality" represents the capacity to accomplish those determinate functions.

The lake Shorezone Functionality Index (SFI) looks at the overall status of the lake environment and assists in the identification of the causes of deterioration, zooming out from the waterbody itself to include all the surrounding territory and watershed topography. The potential of the SFI method lies in the ability of obtaining a synthetic value of lake shorezone functionality. The results obtained provide an immediate general picture of the state of the shores around the lakes. The results can also be used to easily identify the location and the actions needed in potential restoration sites, location of protected areas, location of areas of important economic value and so on. Thematic map can be created for each parameter called in the field and spatial analysis can be carried out to identify the weaker or stronger locations, the areas more in need or more prone to restoration actions[12].

The SFI was developed in Italy in 2004 by a working group of the Italian Agency for Environmental Protection and Technical Services, and has consequently been adopted by several EU countries. The SFI approach has recently been used for assessment of Lake Ohrid's hydromorphology[13]. Results of the analysis have been taken into consideration for delineation of LOW surface WBs; summary information from the analysis is presented further.

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11 Source: "Lake Shorezone Functionality Index, A Tool for the Definition of Ecological Quality"; Maurizio Siligardi et all, 2010).

12 Source: https://North.zennarobarbara.com/resource-management.html#

13 "Shorezone Functionality, Ohrid Lake"; Implementing the EU Water Framework Directive in South-Eastern Europe. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (2017).

2.4.2 Hydromorphological Areas and Main Shorezone Typologies

Seven hydrogeomorphological areas have been identified, characterized by different geological, hydrological and morphological features, which either represent an advantage for or a limitation to the natural growth of a functional shorezone (Fig. 2.14). However, it has also been concluded that at Lake Ohrid the main modifier influencing the structure and functionality of the lake shorezone is anthropogenic pressure.

Hydromorphological area (HGM)	Drainage basin (km^2)	Shore length (km)	Drainage basin/ shore length ratio
I- North Jablanica	40.7	16.1	2.5
II -- Black Drin outlet	18.2	7.2	n/a
III - Northern plains	677.5	13.4	50.6
IV - Karstic Mountains	115.9	23.5	4.9
V - Springs	2.3	8.9	0.3
VI - Southern plains	130.8	8.7	15.0
VII - South Jablanica	62.8	18.8	3.3

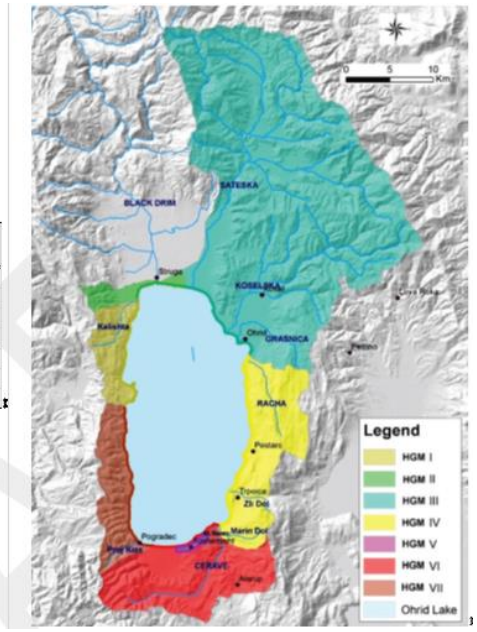

Figure 2.14: LOW: Hydromorphological Areas (in Relation to SFI)[14]

Further, seven shorezone typologies have been identified at Lake Ohrid, which partly correlate with the natural topography of the land surrounding the lake and partly with the degree of human pressure exerted on the lake. In the typologies, the presence or absence of reeds greatly influences the width of the shorezone and therefore its functionality value (Table 2.8).

Table 2.8: LOW: Shorezone Typology (in relation to SFI)[15]

Shorezone Typology	Brief Description
Typology 1 – Wide belt of riparian vegetation (trees and reeds)	Characterized by belt of riparian vegetation, accompanied by reeds in the littoral zone; provides a high value of complexity and functionality; **SFI = 1**
Typology 2 – Narrow belt of riparian vegetation (no reeds)	Narrow belt of riparian vegetation, often due to the natural slope of the terrain; reeds are lacking, which decreases the potential width of the functional shorezone; still provides complexity and good functionality; **SFI = 2**
Typology 3 – Cliffs with limited vegetation	Characterized by cliffs that directly border the lake; shorezone mainly comprises bare rock and scattered shrubs; **SFI = 3**
Typology 4 – Reeds, with little or no terrestrial riparian vegetation	Terrestrial environment of the lakeside plains intensively farmed, natural riparian vegetation removed and replaced with crops. Shallow bathymetry promotes growth of reeds, which perform a number of ecological functions; **SFI = 2/3**
Typology 5 – Thin belt of riparian trees, high artificiality	Belt of riparian trees and/or shrubs, similar to typology 2 but more limited in width; human pressure is the main factor limiting the growth of riparian vegetation; **SFI = 3**
Typology 6 – Artificial shore	Lake's shorezone has been heavily modified to accommodate tourism: artificial beaches; retaining walls; **SFI = 5**
Typology 7 – Impermeable walling with reeds	Impermeable walls interrupt the continuum between the littoral and the terrestrial zone; **SFI = 5**

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[14] Source: Ibid.

[15] Source: Ibid.

2.4.3 Lake Ohrid Shorezone Functionality Index

Summary information regarding SFI for Lake Ohrid are presented in Fig. 2.15.

Overall, 75% of the whole perimeter of the lake falls into the moderate, poor or bad category, which means that most of the shoreline cannot perform ecological functions such as nutrient removal, shore stabilization or provision of habitats for aquatic and terrestrial species. The lake is assessed to be highly vulnerable to diffuse and point source pollution from urban, industrial, agricultural and other activities.

SFI Value	Number of streches	Total length (km)	%
1 - High	6	6.2	7.1%
2 - Good	15	16.1	18.3%
3 - Moderate	19	13.9	15.8%
4 - Poor	3	2.6	3.0%
5 - Bad	44	49.0	55.8%
Total	87	87.8	100%

Figure 2.15: LOW: Shorezone Functionality Index[16]

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[16] Source: Ibid.

3 INSTITUTIONAL SETUP FOR WATER RESOURCE MANAGEMENT IN ALBANIA AND NORTH MACEDONIA

Detailed overview and assessment of the legal, regulatory and institutional setup for water resource and environmental management in Albania and North Macedonia is given as a separate Supplement I. Provided below is a brief outlook of the key stakeholders related to this plan, along with their responsibilities.

3.1 OVERVIEW OF STAKEHOLDERS – ALBANIA

Stakeholder category	Relevant stakeholder	Territorial Jurisdiction	Matter Jurisdiction
LEGISLATIVE AND POLICY DEVELOPMENT COMPETENCES	**Assembly of Albania**	Central level	Legislative and policy development: Laws; ratification of international agreements for RBD management
	Council of Ministers	Central level	Legislative and policy development: approves the composition and regulation of operation of the National Water Council; and the manner of organization and functioning of the Water Resources Management Agency; approves the National Strategy of Water Resources Management; appoints a special commission for cross-border water management; determines the territorial boundaries of each basin waters of the Republic of Albania, as well the center of council composition of each of them; approves the hydrographic boundaries of basins water; approves the river basin management plans; determines areas, distances and width of the shores of water resources
	National Water Council	Central level	Central decision-making body responsible for managing water resources: approves interregional and national plans and projects in the field; takes appropriate measures for the implementation of any international agreement, water management conventions of which the Republic of Albania is a party; issues permits and authorizations for water use and discharges when the activity is performed outside the boundary of a single basin; approves the initiatives of any contracting authority for initiating concession procedure for the use of water resources; approves the regulation of the river basin councils Council, the water basin council and the water basin agency
EXECUTIVE COMPETENCES	**Water Resource Management Agency**	Central level and RBD level	Central governmental body responsible for implementation of the water management regulations and the integrated management of water resources, quantitative and qualitative preservation, and their further consolidation
	Special Commissions for the Management of Transboundary Waters	Central level and RBD level	Special commission tasked with the administration of transboundary waters, managing the relations with the border countries for these waters, based on Albanian legislation and relevant international agreements.
	Ministry of Tourism and Environment	Central level	Drafting and implementing policies, strategies and national plans related to climate change, for the protection of aquatic resources, water resources, inland and temporary water surface, marine water and groundwater.

	National Environmental Agency	Central level	Monitor the state of the environment and to monitor the quality and quantity of water resources and to develop new policies for their protection and improvement. National Environmental Agency monitors wastewater discharges
	National Agency for Protected Areas	Central level	Responsible for protection, management and monitoring of protected areas
	Regional Environmental Agencies	Regional level	Responsible for permitting and enforcing environmental legislation
	State Inspectorate of Environment, Forests and Water	Central level	Enforcement of legislation on environmental protection, forests, water and fishery
	Ministry of Agriculture and Rural Development	Central level	Responsible for water utilization for irrigation purposes and drainage. This ministry is responsible for water utilization for irrigation, for drainage, for the protection of flood systems and for the preservation of fishery resources
	Directorate of Agriculture and drainage boards	Regional level	Technical, specialized structures, responsible for operation and maintenance of drainage, flood protection systems and main irrigation infrastructure (large dams and main irrigation canals)
	Directorate of Water and Fishery Policies-The Fishery and Aquaculture Sect	Central level	Drafting of policies, strategies for fishery and aquaculture development and the preparing of the Fishery and Aquaculture Administration Plan. This sector is also responsible for directing and coordinating the monitoring and controlling system for scientific research projects that relate to sea fishery resources, the evaluation of internal waters, and fishery information and statistics systems
	Ministry of transport and infrastructure: General Maritime Directorate; General Directorate of Water Supply and Sewerage	Central	Elaboration of the policies related to water supply and sanitation. The authority is in charge of developing policies on water supply and sewerage systems, and for investing in waste management facilities
	Water Regulatory Authority	Central level	Regulatory authority, responsible for regulating the sector of water supply and wastewater disposal and treatment in Albania
	Ministry of Health	Central level	Responsible for setting drinking water standards and monitoring the quality of drinking water, bathing water and curative waters, by protecting water sources and the chlorination of supply entering the distribution systems
	Ministry of Energy and Industry	Central level	Responsible for hydropower production and power produced by renewable energy resources
	Ministry of Defence General Directorate of Civil Emergency	Central level	Monitors, manages and controls states of emergency, including floods and other emergencies, in the entire territory of Albania
	Ministry of Economic Development, Tourism, Trade and Entrepreneurship	Central level	Responsible for the planning and approval of tourism policies, and has the duty to ensure and protect the sustainable use of water resources for tourists
MONITORING COMPETENCES	**Institute for Public Health**	Central level	Monitoring the safety of water supply, including water chemical and biological monitoring
	Administration for Hydro-Meteorological Service	Central level	Operation of the hydrological monitoring network, to inform the public on the state of waters and alarm on the appearance of imminent dangerous or harmful hydrological circumstances

	Institute of Geoscience, Energy, Water and Environment	Central level	Monitor surface water quality and quantity; studying and evaluating the country's natural mineral and underground energy and water resources; for groundwater quality and quantity monitoring; for assessing surface water quality for rivers, lakes, underground and marine water; and for monitoring rainfall, temperature and other hydro meteorological parameters
	Albanian Geological Survey	Central level	Groundwater quality and quantity monitoring. It also conducts the watershed hydro-geological studies and recommends measures for the protection of groundwater resources
POLICY AND EXECUTIVE COMPETENCES AT LOCAL LEVEL	**Local self-government Unites (municipalities) and quarks**	Respectively at municipal level	Sewerage and treatment of public waste water, and collection, transport and treatment of municipal solid waste and technological waste
	River Basin Councils	River basin and local level	Integrated management of water resources in the relevant basin at the local level. competent to issue authorizations and permits when the activity is to be carried out within the territory of the Republic of Albania and within the boundaries of a single basin
	Water Basin Management Offices - Agency branches	River basin	Drafts the water resource plan for the respective basin and submits it for approval to the river basin council; inventory of water resources in quantity and quality, Promotes the participation of water users in the management and management of water resources; prepare reports; prepares materials for the meetings of the river basin council; surveillance over implementation of the decisions of the National Water Council and the river basin Council; prepare programs for preventing and avoiding contamination of receiving water resources under their jurisdiction from liquid discharges; compile the program of measures for the water basin; keep a register listing all licenses, authorizations, permits and concessions issued.
	Protected Area Administration of Korca	Municipal level	Monitors and manages protected areas within Ohrid Basin in Albania
WATER USERS	**Water Supply and Sewerage Association of Albania**	Central level	Non-profit association of water supply and sewerage professionals formed by a group of representatives from eight water supply and sewerage enterprises in Albania, to represent the interests of the enterprises operating in the water sector, and to raise the level of professionalism
	Water User Associations (WUAs)	Local level	Private and financially independent entities to manage the irrigation.
	Albanian Union of chamber of Commerce and industry	Central level	Represent and promote the general interests of business chambers for the development of trade and industry at all levels
ORGANIZED INTEREST GROUPS	Environmental NGOs/associations; NGOs dealing with biodiversity conservation and nature protection; Consumer protection associations	Central and Local level	Public participation in the decision-making process negotiate (lobby) on matters of public interest

3.2 OVERVIEW OF STAKEHOLDERS – NORTH MACEDONIA

Stakeholder category	Relevant stakeholder	Territorial Jurisdiction	Matter Jurisdiction
LEGISLATIVE AND POLICY DEVELOPMENT COMPETENCES	**Assembly of Republic of North Macedonia**	Central level	Legislative and policy development: LoW and other lex specialis; Water strategy, Water Master plan; ratification of international agreements for RBD management
	Government of Republic of North Macedonia	Central level	Legislative and policy development: proposals LoW and other lex specialis; Water strategy, Water Master plan; Adoption of RBMP
EXECUTIVE COMPETENCES	**Ministry of environment and physical planning**	Central level	Legislative and policy development: proposals LoW and other *lex specialis;* Water strategy, Water Master plan< proposal, implementation of RBMP
	Environmental Administration (EA) - Department of Waters (DW)	Central level	Executive competences: Water Management Planning and Development; Concession and Inter-Sectorial Cooperation, permitting procedures- water rights/consents,
	Crn Drim River Basin Management Unit	River basin district	River basin management planning and implementation
	Ministry of Foreign Affairs	Central level	Establishment and management of international RBD; conclusion of international agreement/treaty; ratification procedures
	Ministry of Economy	Central level	Proposals for concession for water use, covers ground waters, use of mineral and thermo-mineral resources and electricity generation; including use of water by hydro power and thermal power plants
	Ministry of Transport and Communication	Central level	Responsible for implementation (financing) of infrastructure development programs and projects related to drinking water supply and wastewater collection
	Ministry of Health, Food Directorate, Institute for public health, State sanitary inspectorate	Central and regional level	Water bodies suitable for human consumption and bathing waters, control of the sanitary and protective zones around these bodies, safety of drinking and bathing waters and protection of population from waterborne diseases, hygiene and health ecology, monitoring of drinking water and surface waters, communal hygiene in public facilities, quality control and hygienic-bacteriological status, monitoring of Waters.
	Energy Regulatory Commission of North Macedonia	Central level	Determine tariffs for water management services and enforcement of tariffs
	Ministry of Agriculture, Forestry and Water Management, Administration for Water management	Central level	Manages water use in agriculture (irrigation, land drainage, fisheries), large infrastructure facilities related to use of water such as dams, reservoirs, irrigation/hydro systems, etc. performs expert supervision over the operations of Water Inc. Good agricultural practices
	Administration for Hydro-Meteorological Service	Central level	Tasked with responsibilities for monitoring the quantity and quality of surface and groundwater, operation of the hydrological monitoring network, to inform the public on the state of waters and alarm on the appearance of imminent dangerous or harmful hydrological circumstances
	National Park Galichica	National Park Area	Managing the national park, the protection of nature, biological, landscape diversity and natural heritage

POLICY AND EXECUTIVE COMPETENCES AT LOCAL LEVEL	**Local self-government Unites (municipalities) Ohrid, Struga, Debrca**	Respectively at municipal level	Protection from, and prevention of, water pollution, drinking water supply, drainage, collection and treatment of wastewater. They carry out activities by the own local infrastructure as well as using infrastructure of the communal (municipal) enterprises, which are practically operating as public utilities. LSG units are also responsible for operation of the local monitoring network for the local water bodies within their respective areas; operation, maintenance, and development of the local monitoring network. LSG environmental inspectors carry out inspection functions enforcement for local level competences; determination of prices of water services
ENFORCEMENT COMPETENCES	**State Environmental Inspectorate**	Central level	Empowered to implement the MoEPP responsibilities in the area of enforcement of environmental legislation and, in particular, water management legislation. It covers the obligations for inspection surveillance on central level in the field of environment and, respectively, in the field of water management.
	State Communal Inspectorate (SCI)	Central level	Possesses jurisdiction in the area of public water supply systems and systems for collection, drainage and wastewaters treatment, implemented through its state communal inspectors. The State Inspectorate for Agriculture (SIA) possesses jurisdiction with regard to control of the nitrate vulnerable zones and irrigation and drainage.
	Authorized municipal inspectors	At LSGUs level	Empowered to implement the LSGs responsibilities in the area of enforcement of environmental legislation and, in particular, water management legislation
OPERATORS – PUBLIC INTEREST SERVICE PROVIDERS	**Joint stock company Water Management of the Republic of North Macedonia in state ownership Branch office "Crn Drim)"**	Territory of Prespa (Municipality of Resen); Municipalities of Ohrid, Struga, Vevchani, Centar Zupa, Debar, Kicevo and Plasnica	The water management service is public utility services, i.e. water supply for irrigation and drainage of land and construction and ongoing maintenance and investment in the systems. Water Inc. will use, maintain and manage the irrigation and drainage as a whole, in order to Supply of irrigation water; supply of the communal enterprises with water intended for human consumption (drinking water and other uses); supply of water for industrial and technological (economic) needs including the production of electricity; Regulation of watercourses/ river beds; drainage of land and drainage of discharged waters; responsible for managing the environment, construct and maintain facilities for the protection and defence from floods; - construct and maintain facilities for prevention and protection from erosion; construct and maintain facilities for regulation of the rivers and torrents.
	Public Utility/ Communal Enterprise "PROAKVA" ; PCE "Debrca"	At LSG level relevant for the DRBD	Drinking water supply; and collection, disposal and treatment of sewage and storm water; Plan for tariff adjustment for water services and Business plans for investment.

CONSULTATIVE BODIES	**National Water Council**	National level	Provides independent opinion and improvement suggestions regarding development, ratification and implementation of water management regulating laws and bylaws; adoption of the national water strategy, river basin management plans, etc.
	Crn Drim River basin management council	River basin district	Preparation, implementation and surveillance over the river basin management plans, and for proposing measures for improved water management, opinions of the RBMC are taken into consideration in the planning process at all stages, from beginning to end
ORGANIZED INTEREST GROUPS	Environmental NGOs/associations; NGOs dealing with biodiversity conservation and nature protection; Consumer protection associations	Local level	Public participation in the decision-making process
	Chamber of Commerce EVN North Macedonia,	Local level	Industrial capacities operation Dam regulation Public participation in the decision-making process
	Farmers Association Fishing associations/ concessioner	Local lake level	Public participation in the decision-making process, Good agricultural practice fishing

4 SIGNIFICANT WATER MANAGEMENT ISSUES, DRIVERS AND PRESSURES ON WATER QUALITY AND QUANTITY IN THE LOW

The following section provides an overview of the Significant Water Management Issues (SWMI), along with the actual pressures and the drivers triggering the pressures on the surface and ground waters in the LOW. The description by and large follows the provisions stated in the WFD Reporting Guidance 2016[17].

4.1 DRIVER, PRESSURE, STATE, IMPACT, RESPONSE FRAMEWORK

The pressures and impacts assessment is a four-step process making use of the Driver-Pressure-State-Impact-Response (DPSIR) framework, according to the EU IMPRESS guidance document[18]. The DPSIR framework is seen as giving a structure within which to present the indicators needed to enable feedback to policy makers on environmental quality and the resulting impact of the political choices made, or to be made in the future (Fig. 4.1).

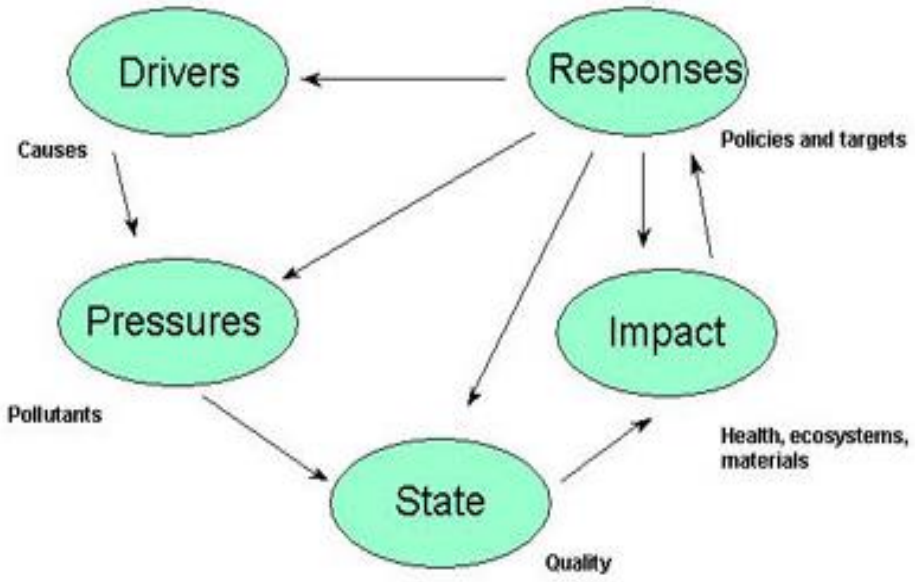

Figure 4.1: The DPSIR Assessment Framework

According to the DPSIR framework there is a chain of causal links starting with 'driving forces' (economic sectors, human activities) through 'pressures' (emissions, waste) to 'states' (physical, chemical and biological) and 'impacts' on ecosystems, human health and functions, eventually leading to political 'responses' (prioritisation, target setting, indicators).

Driving forces are sectors of activities that may produce series of pressures, either as point or non-point sources. The IMPRESS guidance document provides a broad categorization of driving forces, which can be used as a checklist for inventory of the relevant pressures.

The main Driving Forces/Drivers that produce pressure on the water resources of the LOW are the following:

- ✓ urban development;
- ✓ tourism and recreation;
- ✓ fisheries;
- ✓ industry;
- ✓ intensification of agriculture; and
- ✓ hydropower.

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[17] WFD Reporting Guidance 2016, Final Draft 6.0.1, 23 September 2015.

[18] Common Implementation Strategy for the Water Framework Directive (2000/60/EC); Guidance Document No. 3: Analysis of Pressures and Impacts, EC 2003.

Apart from these, Driving Forces in terms of activities as impetuses for change within the DPSIR framework are also:

- ✓ EU accession;
- ✓ The process of EU WFD implementation;
- ✓ promotion of Integrated Water Resources Management;
- ✓ available external funding; and
- ✓ the support of the GWP for transboundary cooperation and institutions establishment for the Extended Drin River basin.

Overall, the DPSIR framework provides the basis upon which to assess the pressures in the LOW. The understanding of the causal relationships between pressure, state and impact, apart from data used from previous studies, was also facilitated by extensive assessments performed within the frame of the GEF Drin Project, which offered sufficient knowledge, background information and data to perform the pressures and impact assessment and select the differential responses to different identified pressures.

The first step for the selection of pressures is based on the identification of the SWMIs according to the WFD requirements.

4.2 IDENTIFICATION OF THE SIGNIFICANT WATER MANAGEMENT ISSUES

According to Article 14 (1) (b) of the WFD, at least two years before the beginning of each river basin planning period the national Competent Authority for development of the RBMP and related Program of Measures (PoM) has to publish, for each river basin district, a summary of SWMIs which are the most relevant for the given river basin district. The overview must be published for consultation for a period of 6 months and should set out, for the river basin district, the main pressures and impacts, which will need to be addressed in the Plan and the PoM. Thus, the identification of SWMIs is one of the key milestones in designing the plan.

Within this framework, the broad consultation organised by the GWP-Med for the approval of the Transboundary Diagnostic Analysis (TDA) and the Strategic Action Programme (SAP) for the extended DRB[19] is considered as well in the selection of SWMIs for the LOW, as well as for outlining the main challenges ahead, which served as basis for selection of the measures in the PoM of the LOW[20].

More specifically, the investigations carried out under the Drin TDA/SAP analysis identified the following problems/pressures with transboundary effects:

- ✓ deterioration of water quality;
- ✓ variability of hydrological regime;
- ✓ biodiversity degradation; and
- ✓ variability of sediment transport regime.

In addition to the Drin Basin TDA/SAP analysis, based on information from a number of prior investigations related to environmental/water resource pressures in the LOW carried out through the past decades, as well as the detailed analysis carried out for preparation of this plan, the following aspects are regarded as SWMIs for the LOW:

- ✓ point-source and diffuse water pollution caused by urban development, tourism, industry, agriculture and fisheries;
- ✓ water quantity/abstractions from agriculture, urban development and tourism;
- ✓ physical condition of the water environment, i.e. flow alteration and diversion;
- ✓ introduced species and diseases;
- ✓ fisheries; and
- ✓ other anthropogenic activities (boating).

The following chapters are dedicated to the pressures and impact assessment based on the identification and prioritisation of SWMIs, followed by the selection of measures addressing the respective SWMIs.

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[19] The Key objective of the TDA for the DRB was to identify, quantify, and set priorities for environmental problems that are transboundary in nature. Consequently, the TDA provided factual basis for formulation of a SAP. The TDA is a document that synthesized the findings of basin-wide Thematic Reports on: (1) Socio-Economics; (2) Institutional and Legal setting; (3) Biodiversity and Ecosystems; (4) Hydrology and Hydrogeology; (5) Pollution and Water Quality; and (6) the Nexus.

[20] Section 7 of this report.

4.3 URBAN DEVELOPMENT, TOURISM AND RECREATION

4.3.1 Abstraction for Public Water Supply (Households, Public Sector and Tourism)

From a viewpoint of potential impact on the overall balance of water resources, most water abstractions are currently sustainable in the LOW. Relatively large amounts of water are abstracted daily for domestic use and for use in industry and recreation. Most of this water is treated to a high standard to remove impurities and make it appropriate for consumption.

Table 4.1 below shows the volume of annual water abstractions by municipalities in the LOW for use by households, public/commercial institutions, small-scale industry and tourism/recreation facilities; more detailed data is given in Appendix B. The total population connected to a public water supply systems, i.e. systems that are operated by a municipal communal public enterprise, is estimated at 115,842 (88% of the total population), or 56,372 household connections. In addition, roughly 3,700 residents in the basin use local community-based water supply system, and some 12,500 (9% of the total) have a self-organized water supply. The number of commercial and industry connections to the public water supply system varies by municipalities, with a peak of 2,300 connections in Ohrid, indicating the relatively large number of tourist facilities in the municipality. The total average annual volume of water abstractions for the listed uses is estimated at 14 mill m^3. The overall unit water production (water input into the systems) equals 331 l/cap/daily, whereas the unit water consumption equals 136 l/cap/daily, resulting in large ratio of non-revenue water (59% for the basin as a whole).

Table 4.1: LOW: Water abstraction for Domestic, Public, Industry and Tourism Use by Municipalities[21]

Municipality	Administrative Unit	Population	Population connected to central WS system	Number of HH connections	Number of comm/ind connections	Total water input volume (m3/year)	Total billed consumption (m3/year)	Unit water production (lcd)	Unit water consumption (lcd)	Non-revenue vs. total water input ratio
Pogradec	Buçimas	15,687	45,910	11,772		3,100,059	1,843,278	185	75	59%
	Çerravë	7,009								
	Dardhas	2,182								
	Pogradec	20,848								
	Hudenisht	5,990								
Debrca		3,994	1,876	1,051	22	217,614	188,766	318	276	13.3%
Ohrid		51,850	46,937	29,400	2,301	8,916,955	3,091,128	520	180	65.3%
Struga		24,498	21,119	14,150	562	1,771,346	619,187	230	80	65.0%
TOTAL in LOW		**132,059**	**115,842**	**56,372**		**14,005,974**	**5,742,359**	**331**	**136**	**59.0%**

Map 4 shows the abstraction locations in the North Macedonia part of the LOW. Major part of the abstractions are either wells (pumped groundwater) or captured springs with varying capacities. However, four locations were also identified where water from Lake Ohrid is directly pumped, treated and used for water supply.

As a specific problem related to water abstractions, the non-revenue water is very high in all cases (Table 4.1). The extent and impact of the underlaying causes for this situation, such as physical water losses, unaccounted-for water, etc., are beyond the scope of this analysis. However, the high non-revenue water ratios lead to an undisputable conclusion related to presence of significant inefficiencies in utilities' operation, thus overuse of water resources.

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[21] Source: North Macedonia: "Water Supply and Wastewater assessment of existing situation and Gap Analysis", The EU Operational Programme for Regional Development 2007-2013, Eptisa (2015); Albania: International Benchmarking Network for Water and Sanitation Utilities (IBNET, 2015).

4.3.2 Wastewater discharge (Households, Public Sector and Tourism, Point Source)

Alike water supply, organized waste water management (WWM) service in the LOW is provided by municipal communal public enterprises (CPE). The coverage of the population with WWM service varies significantly between the LOW municipalities (Fig. 4.2 and Appendix C). The overall ratio of households connected to public wastewater collection system for the basin equals 72%; the remaining 28% are assumed to use septic tanks for discharge of waste water. However, the ratios of population connected to central WWM system varies from 11% in Debrca municipality, 61% in Pogradec, and roughly 84% for Ohrid and Struga municipalities.

Municipality	Population	Population connected to sewer/ WWTP	Septic tanks
Pogradec	51,716	31,313	20,403
Debrca	3,994	449	3,545
Ohrid	51,850	43,104	8,747
Struga	24,498	20,656	3,842
Total	132,059	95,521	36,537
		72%	*28%*

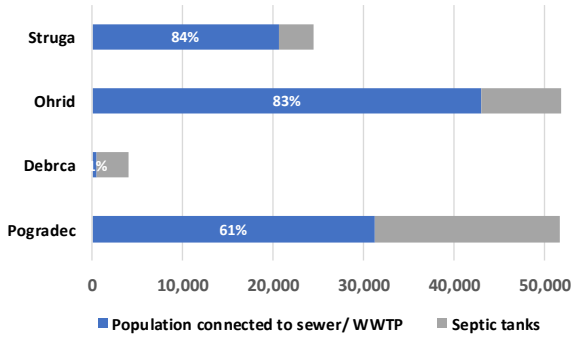

Figure 4.2: LOW: Wastewater Management Service Coverage by Municipalities (2015)[22]

Another important aspect related to WWM in the LOW is the presence of a large number of tourists in the region (section 2.2), and in particular the distribution of visitors and overnights throughout the year, which creates significant imbalances of pollutant load to water bodies (Figure 4.3: LOW: Distribution of Tourists and Overnight Visitors in Ohrid and Struga (2015 - 2017)). Based on available data, roughly 73% of the tourists visit the Lake Ohrid region in North Macedonia during the summer period (May through September), and even over 85% of the overnights take place during the June – October period. It is assumed that a similar pattern of visitors is applicable also on the Albanian part of the basin.

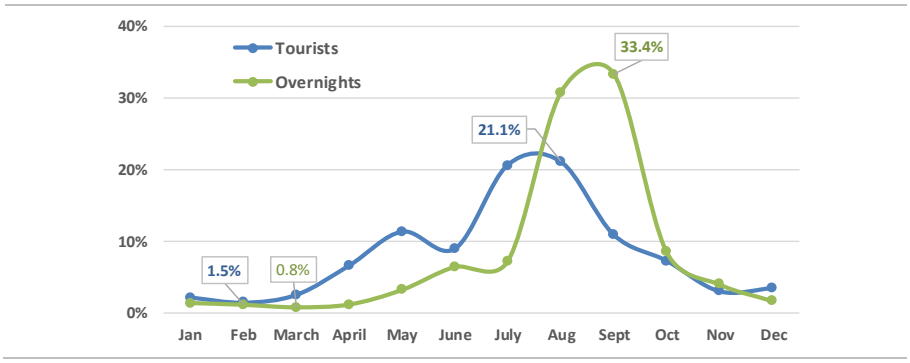

Figure 4.3: LOW: Distribution of Tourists and Overnight Visitors in Ohrid and Struga (2015 - 2017)[23]

At present there are two main/central waste water treatment plants (WWTP) in the LOW – WWTP Vranishta near Struga and WWTP Tushemisht in Albania (Map 10). In addition, there are several decentralized small-scale WWTPs on the North Macedonia part of the basin targeting mainly local tourist facilities (e.g. Campsite in St. Naum, Campsite in Radozda, Biser Hotel in Kalishta, etc.).

WWTP Vranishta is operational since 1988, and has a total installed capacity of 120,000 population equivalents (PE). The current maximum load of the plant equals roughly 80,000 PE, of which 64,000 PE from local population connected to the plant and roughly 15,000 PE (as a daily maximum) from tourists residing in facilities around Ohrid and Struga that are connected to the central WWM system/WWTP. Two primary waste water collecting branches are connected to the WWTP with total length of toughly 40 km, covering a perimeter around the lake from the

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[22] Source: Ibid.

[23] Source: State Statistical Office of North Macedonia

village of Peshtani south of Ohrid, the city of Ohrid and several major villages to the North-east, the Ohrid-Struga shoreline, the city of Struga, and the Elen Kamen-Struga section along the lake north-west of Struga. There are a total of 13 pump stations for transport of collected waste water in the primary sewer branches[24].

WWTP Vranista employs an oxidation ditch process, wherein two units/reactors are used for the wastewater treatment process in a cycle. The influent is mixed from both volumes of wastewater from the Ohrid and Struga sides. Subsequently, an influent pump station inside the plant lifts the wastewater to a mechanical screen unit and pre-treatment channels. Two spherical reactors are followed by channels and the influent is biologically treated using activated sludge. After the biological process, water is conveyed to the clarifiers to settle activated sludge by gravity, whereupon the treated water is discharged into Black Drin river. Equipped chlorination channels are usually used for final disinfection before discharging.

The WWTP is equipped with two reactors to mature the condition of the activated sludge and a gravity thickener is used to separate the sludge component by settling. After the thickening process a dual-unit belt filter press is used to dewater the thickened sludge using a polymer coagulant for a dewatering aid. Finally, the dewatered sludge is placed onto sludge drying beds under sunlight. Dewatered sludge is given to nearby farmers free of charge, which functions well and eliminates the need to find a final dumping site for the dried sludge.

According to data from the referenced study, the BOD, COD and total suspended solids components taken at the WWTP influent show significant fluctuations throughout the year, but when only data for recent years are compared, influent records showed a relatively constant tendency for the influent contents to be more concentrated during the summer and less in the winter. The BOD in the influent tends to peak in July and August, ranging around 125-131 mg/L during 2008-2011; COD is usually analyzed as CODCr and usually peaks in the summer, ranging around 200-274 mg/L during 2008-2011. Total suspended solids show no clear seasonal tendencies, with recorded values fluctuating significantly.

With regard to the water quality components in the effluent for the 2005-2011 period, BOD remained below the criteria regulating at 25 mg/L or less throughout the year; COD showed below the limit at 125 mg/L throughout the year[25]. Total suspended solids sometimes exceeded the limit of 35 mg/L but averaged between 12 and 31 mg/L. Thus, the average annual BOD reduction ratio for the stated period ranges between 79.8% to 92.8%, COD between 69.5% to 93.5% and the reduction of total suspended solidsa varied between 80.3% and 97.9%. Identified key problems resulting in inefficient operation of the Lake Ohrid central WWM system in North Macedonia include:

- ✓ infiltration of groundwater and water from the lake into the system;
- ✓ intrusion of stormwater in the system (lack of separate drainage system for stormwater);
- ✓ lack of information on existing system inventories;
- ✓ defective pump stations; and
- ✓ inefficient operation of the WWTP as a result of variation of effluent quality (due to ground and storm water inflow)[26.]

WWTP Tushemish in Albania is operational since 2009. The plant has an installed capacity of 40,000 PE; the current load is roughly 31,000 PE. The plant is located near the village of Tushemisht, and by and large covers the city of Pogradec and surrounding settlements along the lake in the Buçimas Administrative Unit[27].

The plant is designed to achieve the effluent discharge standards of: 25 mg/L of BOD,125 mg/L COD, and 1000 MPN faecal coliforms/100 ml. The effluent meets thesestandards. It is envisaged that nutrient removal will be progressively introduced to reduce eutrophication load on Lake Ohrid, as follows: 2 mg/L P from 2017 and 15 mg/L N from 2027. The negative impact (pollution load) from discharge of waste waters per separate water bodies is estimated based on the following assumptions:

- ✓ population (not) connected to central WWM system/WWTP (Fig. 4.4);
- ✓ maximum daily number of tourists (not)connected to central WWM per WB;
- ✓ unit load of BOD for the population and tourists (60 grams per capita daily) and the industry (assumed 15% of residential load); and
- ✓ BOD removal ratios of 90% for the WWM system and 30% for septic tanks[28].

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[24] Source: “Data Collection Survey for Ohrid Lake Environmental Improvement”, Final Report. Japan International Cooperation Agency (JICA), MoEPP (October 2012).

[25] Reference: Council Directive 91/271/EEC of 21 May, 1991 concerning urban wastewater treatment.

[26] Source: Ibid.

[27] Sources: “Environmental Impact of The Pogradec Wastewater, Estimated Through the Global Pollution Index Method”; The Annals of “Valahia” University of Targoviste (2010); “Wastewater Treatment and Current Sludge Management Practices in Pogradeci Region”; Agricultural University of Tirana (2018).

[28] Adopted from: “Data Collection Survey for Ohrid Lake Environmental Improvement”, Final Report. Japan International Cooperation Agency (JICA), MoEPP (October 2012).

Summary of the results from the analysis are given in Appendix C and Map 10.

In general, critical zones (WBs) in this regard are the ones with discharges not connected to sewerage network, which include:

- ✓ the south-east section (WB Velidab – i.e. predominantly tourist locations at Trpejca, Ljubanishta and St. Naum);
- ✓ North-west section (WB Kalishta and Radozda) along the lake in North Macedonia;
- ✓ the North-west section along the lake in Albania (WB Lin);
- ✓ WB Çeravë and WB Pogradec in Albania, mainly as a result of important part of the population and tourists not connected to WWM system; and
- ✓ AWB Studenchishki kanal near the city of Ohrid.

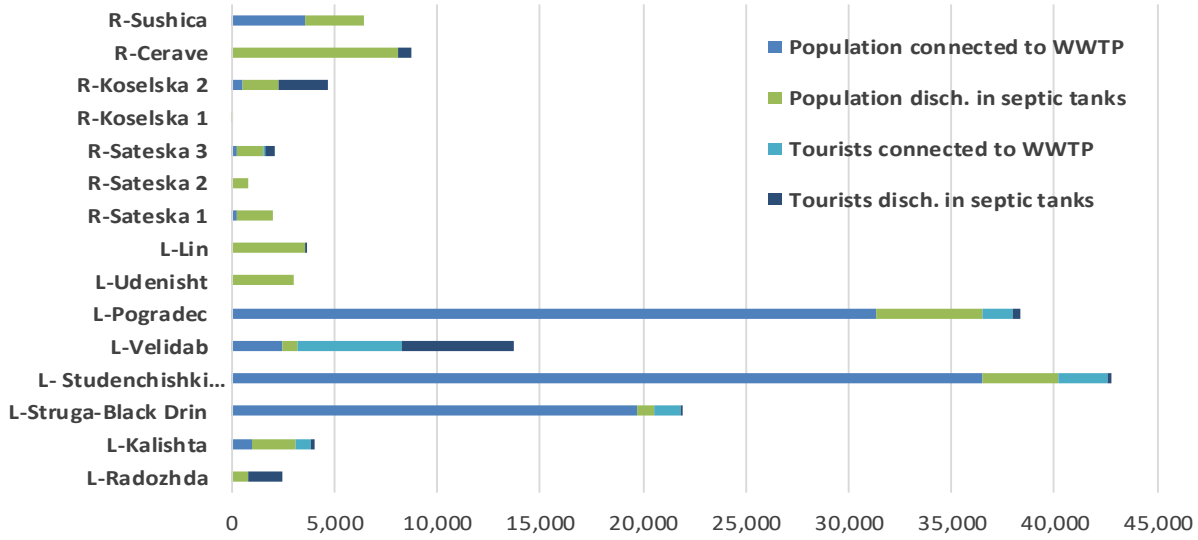

Figure 4.4: LOW: Waste Water Service Coverage by Water Bodies (Population and Tourists – Max Daily Visitors)

4.3.3 Waste Management

Dominant form of organization regarding waste management (WM) in the region is the existence of service companies (utilities) providing collection and disposal of solid wastes generated by the population and the industries on a municipal level. In Albania, Pogradec Municipality has a Waste Management Plan since 2017; the waste management service is carried out by Korca Region waste management, through Landfill of Maliq. The situation is similar in Ohrid and Struga Municipalities in North Macedonia.

Table 4.2 and Map 11 provide key information regarding management of wastes in the LOW[29].

Overall, as is the case with water supply and WWM, the WM service coverage varies between municipalities in the basin. The unit generation of solid waste in the basin ranges from 0.55 kg per capita daily in Debrca to 1.0 kg/cap/day in Pogradec.

In addition, notable difference is identified between unit waste generation in urban areas, where it goes up to 1 kg/cap/day, and rural areas frequently having 0.4-0.5 kg/cap/day.

For the basin as a whole, the total daily volume of municipal solid waste generated equals 118 tons, or nearly 43,000 tons/year.

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[29] Source: "Thematic Report on Socio-Economics of the Extended Drin River Basin; The Global Water Partnership – Mediterranean (GWP – Med), November 2017.

Table 4.2: LOW: Status of Waste Management

Municipality	Administrative Unit	Population	SWM service coverage	Waste generation			Waste disposal	
				kg/cap/day	tons/day	tons/year	Controlled landfills	Illegal dumps
Pogradec	Buçimas	15,687	90%	1.0	51.7	18,876	15,021	3,855
	Çerravë	7,009						
	Dardhas	2,182						
	Pogradec	20,848						
	Hudenisht	5,990						
Debrca	N/A	3,994	53%	0.55	2.2	802	0	802
Ohrid	N/A	51,850	100%	0.9	46.7	17,033	15,670	1,363
Struga	N/A	24,498	80%	0.7	17.1	6,259	5,320	939
TOTAL in LOW		**132,059**	**91%**		**118**	**42,970**	**36,012**	**6,959**

In terms of quality and environmental standards of the discussed WM service, it should be pointed out that it is by and large at a low level. Thus, the service is mostly centered around municipal centers and larger villages, leaving the smaller, rural settlements without any organized service. In addition, even for the bigger urban and rural settlements that do have organized WM service, it is limited to collection and transport of communal waste to a central, designated or 'controlled (authorized) municipal' landfill. The rural settlements are thus forced to manage the waste on their own, which in most cases ends up with citizens transporting waste to a village dump.

The management of the special waste types in the LOW largely remains an unanswered aspect. In particular this refers to management of hazardous wastes, such as medical waste. To the extent of consultants' knowledge and experience from the region, bulk part of the hazardous waste components found in communal solid waste streams (e.g. batteries) end up in municipal landfills.

There are three larger (municipal) landfills in the basin (Map 11)[30]. Regrettably, these landfills are not compliant with the EU standards. Collected wastes are commonly dumped over the edges of the sites, and a bulldozer is used to compact the deposits and place cover material over a portion of the exposed waste. Quite often there does not appear to be an accessible amount of soil material for creating a waterproof soil cover, resulting in significant volumes of disposed wastes continuously opened to the atmosphere. Landfill fires occur frequently. Pollutants, mainly decomposed organic matter, metals and fuel, from the bottom of the landfills seep into the ground and travel through groundwaters, thus making the pressure from improper WM among the key threats to water resource quality in the LOW.

4.4 INDUSTRY

Industrial production facilities in both Albania and North Macedonia are subject to environmental permitting. The permitting process is governed by environmental legislation and linked to environmental impact assessment procedures.

In Albania the system of environmental permitting is established by the Law on Environmental Impact Assessment, the Law on Environmental Permitting, and the Law on Licenses, Authorizations and Permits in the Republic of Albania. Three types of environmental permits, depending on the thresholds of industrial activity, production and capacity, are issued: Types A, B and C. The State Inspectorate of Environment and Forests is responsible for inspection, compliance checking and the enforcement of environmental permit requirements[31].

In North Macedonia the permitting process is also managed by the Ministry of Environment and Spatial Planning. Depending on the size and capacity of the industrial activity/plant, two types of environmental permits are issued – Type A and B. Type A refers to major production capacities and is managed directly by the Ministry. Type B permits are required for smaller production processes and are issued by environmental departments within Local Government Units (municipalities).

Major part of the industry in the LOW is located close to the urban centers of Pogradec, Ohrid and Struga. The most common industrial activities on the Albanian part of the basin include mineral (iron-nickel) exploitation and chromium mining, while on North Macedonia part construction industry (concrete production), food processing (poultry farms), wholesale and retail trade, transport.

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[30] The municipal landfill near Struga, although formally outside of the LOW, is located practically on the very edge of the basin and is thus taken into consideration.

[31] Source: http://North.themisnetwork.eu/tools/standard-operating-procedures/albania/pollution-and-nature/environmental-permits.html.

A total of 26 registered industrial operators eligible for environmental permitting as per the existing national regulations[32]. The type of facilities (IPPC A or B)[33] and their distribution by municipalities and SWB is presented in Map 11 present overview of the locations of registered industrial sites in the basin.

Municipality	Administrative Unit	Industry permits	
		Type A	Type B
Pogradec	Çerravë		1
	Pogradec		1
	Hudenisht		9
Debrca	N/A		3
Ohrid	N/A		6
Struga	N/A	1	5
TOTAL in LOW		1	25

WB Name	Industry permits	
	Type A	Type B
R-Cerave		1
Hudenisht		10
R-Sateska 1		1
R-Sateska 2		2
R-Koselska 2		5
R-Sushica		1
Struga-Drim	1	4
Kalishta		1
Total	1	25

Figure 4.5: LOW: Industry per Municipalities and WBs

4.4.1 Abstraction for industrial water supply and waste water discharge from industry

All these industries use both drinking and technical water in their operation processes. Depending on their needs and possibilities, drinking water is commonly supplied via a public water supply system, and technical water via separate water supply systems from reservoirs or rivers, or from own wells usually located in their vicinity. Besides water supplied from a public system that is regularly measured, there is no precise data on the used amount of technical water from the wells, rivers or reservoirs. There are only isolated cases where the total amount of water used in the production is regularly measured.

Industrial and other similar operations in the basin create important pressure to basin's water bodies caused by the emissions of various pollutants from the technological processes. Industrial waste, wastewater and storm water discharges from industrial facilities are among the contributors to the degradation of the aquatic ecosystems.

4.4.2 Contaminated/Abandoned Industrial/Mining Sites

In addition to eutrophication, Lake Ohrid also is under pressure of metal pollution near the sites of abandoned old chromium, iron, nickel and coal mines outside Pogradec in Albania. Preliminary samples that Albanian scientists have collected at the Guri i Kuq mine show concentrations of metals in the near shore lake water that are importantly high. It is likely that muds and sands in these near shore locations are also contaminated, and this may pose a risk to the invertebrates, fish and birds living in this section of the lake. It is possible that local drinking water sources are at risk of being contaminated.

4.5 AGRICULTURE

Unsustainable practices in agriculture production can cause serious pressures on natural resources, especially soil and water, affecting its ecosystem services. In general, agriculture causes a diffuse (non-point) pollution of surface and ground water bodies with nutrients, pesticides, sterile sediment and organic polluters. Overview of agriculture activities in the LOW and the pressure on water resources created by these activities is provided further; detailed analysis is included in Supplement III.

Agricultural production in the LOW is by and large organized within small households. Out of the whole number of households in the Southwestern region in North Macedonia, more than 72% are smaller than 1 ha, while more than 95% are up to 3 ha, divided into several parcels with average size less than 0.1-0.2 ha. Statistical data for Albania reveals similar situation as well, regarding the farm and parcel size. Most of the production is for self-consumption or for green markets during the touristic season.

Estimation of the land use in the North Macedonia part of the LOW is based on the Land Parcel Identification System (LPIS), which allows identification of land use on a parcel level within several categories. For the Albanian part of the basin statistical data coupled with photo-interpretation of a satellite image from 2018 vegetative season (Sentinel 2) was used for identification of areas under different categories of land use.

Taking into consideration identified land use types and areas under certain land use type, the intensity of agricultural production and location, it can be concluded that there are significant differences in the intensity of

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[32] Sources: Albania: "Pogradec Terrestrial/Aquatic Territory Protected Landscape Area Management Plan", Final Report (2013); North Macedonia: Municipal records (Ohrid, Struga, Debrca) of issued IPPC B permits.

[33] IPPC – Integrated Pollution Prevention and Control.

pressure from agriculture within each of the WBs on water resources. To this end, water bodies in the watershed can be categorized in four groups, as follows:

- ✓ water bodies with small agricultural area and dominance of low intensity field crop production and natural vegetation, distant from Lake Ohrid or its tributaries, like: Koselska 1;
- ✓ second group of water bodies are those with significant areas of agricultural land distant from Lake Ohrid but close to one of its tributaries, like: Sateska 1 and 2 in North Macedonia side Çeravë WB in Albania;
- ✓ the third group of water bodies are those with small areas of low intensity agricultural production that are close to Lake Ohrid, like: Velidab, Studenchishki kanal, Kalishta, Radozda, Lin and Undenisht; and
- ✓ the fourth group of water bodies that have heavy influence on water resources due to big areas of intensive agricultural production like: Pogradec, Sateska 3, Koselska 2, Sushica, Struga-Drim and Lin.

The total agricultural land in the LOW equals nearly 25,500 ha including pastures, while arable land is 9,960 ha or 31.9% of the total (Table 4.3).

Within the arable land the category 'field crops' covers the majority of the agricultural land with over 8,225 ha (92.6%). Most of the area under field crops, according to data from performed field visits, consists of cereal crops: wheat and maize, and small areas of forage crops, mining that the majority of this category is under in-extensive, low input systems of agricultural production. There are certain areas with vegetable production within the category of mixed land use mainly within the house yards in the villages, like: potato, cabbage and beans production. There is a more significant production of beans in the Çeravë WB. Orchard and vineyards are more intensive systems of agricultural production with higher inputs of fertilizers and pesticides. Majority of these three land use types with a total of 10.44% of the agricultural land are spread in Koselska 2, HMWB Sateska 3, Çeravë and Pogradec WBs. These categories of land use, having in mind the intensity of production and inputs and its closeness to the lake shore, can be designated as areas with high risk for pollution of water resources.

Table 4.3: LOW: Land Use

Water Body	Land use (ha)						
	Field crops	Orchards	Perennial plantations	Mixed per. plantations	Vineyards	Pastures	Total
Lake Water Bodies							
L-Radozhda	21.5	0.7	0.8	0.0	1.6	23.8	48.4
L-Kalishta	118.4	0.1	0.4	0.3	0.0	80.1	199.4
L-Struga-Black Drin	345.8	23.8	5.6	0.4	0.5	118.8	494.9
L-Sateska							
L-Koselska							
L-Ohrid bay							
L-Velidab	137.9	4.6	39.8	1.2	20.4	4,872.6	5,076.6
L-Bay of St. Naum							
L-Tushemisht							
L-Pogradec	950.1	67.4	11.5	0.0	62.4	516.3	1,607.8
L-Udenisht	256.3	17.9	0.0	0.0	16.6	53.1	343.9
L-Lin	204.9	13.1	0.0	0.0	12.2	34.6	264.7
L-Lake Ohrid-Pelagic							
River Water Bodies							
R-Sateska 1	2,054.4	14.6	9.4	0.0	0.4	4,844.1	6,922.8
R-Sateska 2	429.3	91.4	17.7	0.0	106.6	293.4	938.3
R-Sateska 3	810.4	153.5	18.5	1.1	35.1	247.2	1,265.8
R-Koselska 1	12.6	0.6	0.0	0.0	0.0	779.7	793.0
R-Koselska 2	943.0	315.3	28.1	0.9	70.3	1,533.1	2,890.8
R-Cerave	1,370.5	162.0	16.6	0.8	107.0	494.2	2,151.0
R-Sushica	538.4	184.5	41.5	2.2	24.3	1,578.5	2,369.4
AWB- Studenchishki kanal	32.2	4.1	3.7	0.0	9.3	67.3	116.6
Total	**8,225.8**	**1,053.8**	**193.6**	**6.8**	**466.6**	**15,536.8**	**25,483.3**
	32.3%	***4.1%***	***0.8%***	***0.03%***	***1.8%***	***61.0%***	

The total area of greenhouses in the basin is negligible. Vegetables are estimated on approx. 1,540 ha of the arable land. The dominant crops within the vegetables group are beans and onion. Land use categories like orchards, vineyards and perennial and mixed perennial plantations are more intensive systems of agricultural production with higher inputs of fertilizers and pesticides. Majority of areas within these land use types, which cover 1,721 ha (17.3%) of the arable land of the catchment area, are mainly distributed within Koselska 2, Sateska 2 and 3, Struga-Black Drin, Sushica and Çeravë and Pogradec[34] WBs.

The remaining part of the agricultural land are under pastures, which cover 15,537 ha (61%). Areas within this land use category are mainly covered with meadows, permanent grass or natural pastures. This category of land use have a very limited human attention, due to what cannot be considered as areas with potential risk of diffuse pollution.

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[34] Data referred to Pogradec in this section belong to Bucimas Administrative Unit only.

4.5.1 Diffuse pollution – fertilizer and pesticide use

Fertilizer and pesticide use in agriculture is a prerequisite for sustainable production in terms of yields and quality of the agricultural products. For these reasons its usage especially in the modern and intensive systems of production is unavoidable practice. Depending on the area of agricultural land threated and its vicinity to water resources, inputs of high quantities of agro-chemicals, especially if used without plans and programs for its use (fertilization and plant protection plans), can cause serious damage to natural resources. If used in an excessive quantities the mineral fertilizers and pesticides on a long run can cause contamination of soil and ground and surface water. In addition, excessive quantities of mineral nutrients can have negative impact on the soil production potential and agro-biodiversity, as well as negative economic impact for the producers.

The total agriculture area treated with fertilizers in the LOW is estimated on 9,960 ha, which is less than 50% of the total agriculture area. The estimated total annual quantities of applied fertilizers equals 3,950 tons, with average input of 400 kg of mineral fertilizers per hectare in one vegetation season. The total nitrogen applied is estimated on 637 tons/year, while the phosphorus and potassium quantities are estimated on 314 and 332 tons/year respectively. It should be noted that in these figures the quantities of nutrients applied with organic fertilizers are not included.

The distribution of fertilizer quantities per water body catchments depends to the total agricultural area and the structure of land use types. Water bodies with highest fertilizers inputs are: Çeravë (647.4 t/year); Koselska 2 (632.1 t/year); Pogradec and Sateska 1 with more than 560 tons/year; Sateska 3 and Sushica with quantities of about 270-280 tons/year; and Sateska 2 with more than 200 t/year (Fig. 4.5; Map 12). These quantities of fertilizers in some cases, due to closeness to the surface or ground water resources, represent serious direct threat to waters of Lake Ohrid (e.g. HMWB Sateska 3, Sateska 2 and Struga-Black Drin), or to its tributaries Koselska river (Koselska 2) or Çeravë. For these reasons particular attention to the optimization of fertilizers application and measures for improvement of the efficiency of nutrients uptake, should be paid in the future.

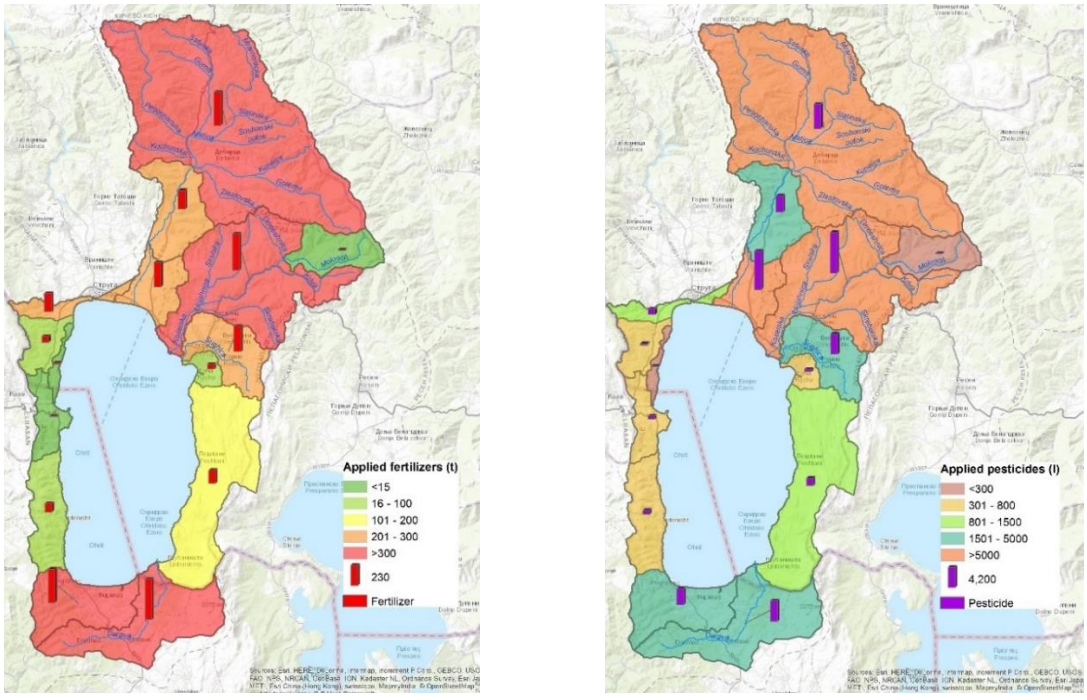

Figure 4.6. LOW: Fertilizer and Pesticide Use in LOW, by Water Bodies Catchments

The retention of nutrients in soil and ground water is result of the excessive quantities or biased application of fertilizers. According to the analysis the yearly accumulation of nitrogen in the basin yields 135.96 t and 118.45 t/year of phosphorus, while potassium is in deficit of more than 252 t/year, meaning that this element is amended from the natural soil abundance. The highest quantities of retention are in Sateska 1, Sateska 3 and Koselska 2 in the North Macedonia part of the basin, and Çeravë on the Albanian side. The quantities of accumulated nutrients every year are alarming and emphasizes the need of sound and concrete action for optimization of fertilizers use, since nutrient pollution might have a serious negative impact on the aquatic environment. Excessive presence of nitrogen and phosphorous in the water causes algae to grow faster than ecosystems can handle. In addition, the excessive use of mineral fertilizers, especially inorganic nitrogen, leads to acidification of soil, also known as agrochemical pollution.

The use of pesticide is estimated on a total area of 7,408 ha, with a total input of 45,400 liters of pesticides, or on the average 6.12 l/ha. The net area of vineyards and orchards on WB level plus an estimated percentage of field crops area are used as basis for calculation of areas treated with pesticides. For estimation of the quantities of pesticides used per hectare agricultural land, data collected during field survey and field historical field survey data were used as well as data from the local authorities regarding the quantities of used pesticides in the region. The average quantities of applied pesticides significantly differ depending to the type of pesticide or the crop type. For instance, in average pesticides in vineyards are applied 2-3 times in quantities of 3-3.5 liters, while in cereals they are used 1-2 times per year in quantities of 2-3 liters, which is in line with the estimation of 6.8 l/ha as an average for all land use types.

Of the total treated area of 7,408 ha over 4,800 ha (64.9 %) are in water bodies catchments in the North Macedonia side of the basin, of which 3,124 (65%) are within three WB river basin (Sateska 1, Sateska 3 and Koselska 2). On the Albanian side the total treated area is 35% out of total 7,408 ha, while more than 70% of the treated area is in Çeravë and Pogradec WB watersheds (Fig. 4.5; Map 13).

Taking in consideration the location of the above-mentioned water bodies it can be concluded that the first two – Koselska 2 and Sateska 3 – can generate serious direct diffuse pollution to Lake Ohrid and the groundwater as well through leaching of nitrogen and residues of pesticides, while the other three water bodies have direct influence on Lake Ohrid tributaries: Sateska, Çeravë and Sushica rivers. Nevertheless, due to the high input of pesticides in these water bodies despite its indirect influence on Lake Ohrid, they can be considered as zones with high risk of diffuse pollution of the lake. On the other hand, the pesticide loads in some water bodies are with negligible quantities, such as: Koselska-1 and Radozhda with 29.7 and 87.6 liters respectively.

4.5.2 Abstraction/hydrological Alteration of Surface and Ground Water for Irrigation

Although the LOW is situated in a region with 662.3 mm/year as total sum of precipitations (period 1970-2000) and thus is considered as more humid than the country averages, still irrigation, especially in the modern and intensive systems of production, is an essential agro-technical measure for achieving of high quality and stabile production. As mentioned before, of the total agricultural land nearly 83% are field crops, of which only cereals, vineyards and some forage crops can be cultivated under rain feed conditions, while all other crops within this category need to be irrigated.

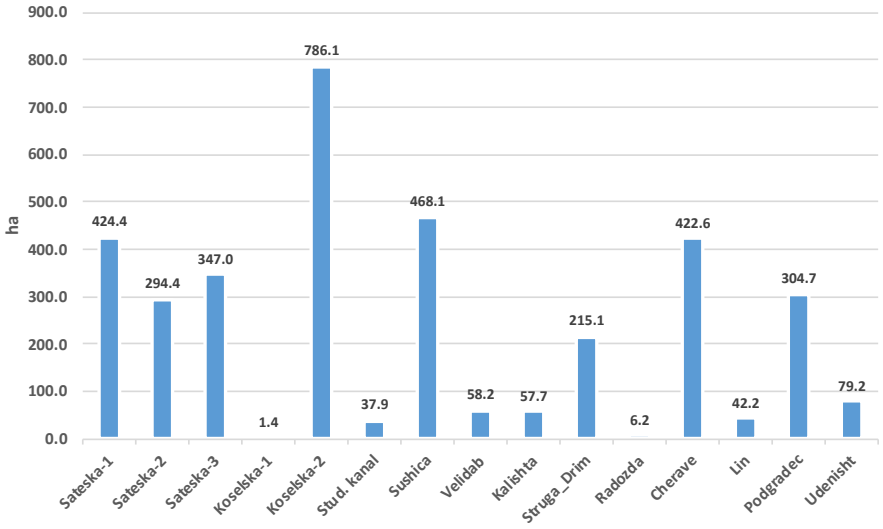

Figure 4.7: LOW: Irrigated Agriculture Area by Water Bodies catchments

Estimation of the irrigated area in the watershed is based on the area occupied with certain categories of land use and field visits and delineated with support of available graphical data sets with GIS technology. The territory of irrigated arable land on both sides of the lake is estimated on 3,545 ha, of which almost 76.1% are in North Macedonia, mostly situated within four WB Sateska 1 and 3, Koselska 2 and Sushica catchments. On the Albanian side, the total irrigated area is around 850 ha, of which more than 85% is situated within Çeravë and Pogradec WB watershed (Fig. 4.7).

In terms of abstractions of surface waters there are 4 small water reservoirs in the basin that are used for irrigation. According to the existing data, there is no functional irrigation schemes in place within the basin, except some cases of a very small areas where small irrigation schemes were functioning in the past. Abstraction of surface water is not a common practice in the basin and is used in some areas near to a big water courses, like Koselska, Sateska or Çeravë river, or areas very near to the lake, like Tushemisht, Studenchista, Hudenisht, etc. Surface abstraction is mainly used for furrow irrigation and mostly applied on spring crops that are traditionally cultivated in

rows which enables application of this technique. For these reasons, it is estimated that only a small part of no more than 10-15% of the irrigated area is irrigated with abstraction of surface water.

Based on available data from recent masurement, in other basin, the level of groundwater is decreasing mainly as a result of unsustainable irrigation practices. According the available statistical data and on the basis of applied crop structure, it can be estimated that the biggest part of the groundwater used for irrigation in the LOW is applied through furrow irrigation. Almost 53% of the irrigated area in North Macedonia and 83% in Albania are irrigated with furrows, while a smaller part is irrigated through sprinkler irrigation.

4.5.3 Animal Husbandry – Farming

The total number of animals in the LOW is over 39,300 heads and nearly 94,000 units of poultry, according to data from the MAFWE`s Regional Office in Ohrid and the Regional Office of MARD in Korcha. The total number of cattle is 4,313, almost evenly distributed on the both sides of the lake catchment. In most cases agricultural holdings are breeding dairy cattle in a small heard of less than 5 or in many cases 2-3 heads. The total number of dairy cattle is 48,2% out of the total number of cattle, mainly distributed within several WB catchments which according the previously analyzed land use, can provide a solid base for livestock, like: Sateska 1, Koselska 1, Pogradec and Çeravë.

The total number of sheep in the basin is estimated to 24,462 heads, kept in small herds of less than 500 heads and mainly located at remote location in rural areas. More than 60.1% of the total number of sheep are located within four WB catchments: Sateska 1, Struga-Black Drin, Pogradec and Çeravë. Estimated number of goats is 9,768 distributed similarly like sheep within several WB catchments: Sateska 1, Koselska 2, Pogradec and Çeravë. Almost 71% of the total number of goats are situated within these four water bodies watersheds. Pigs are represented in a very small number of just 760 units, of which nearly 50% are in Sateska 1 WB catchment.

Table 4.4: LOW: Animal Husbandry

Water Body	Animal husbandry in animal units (AU)				
	Cattle	Sheeps	Goats	Pigs	Poultry
L-Radozhda	43,1	27,2	22,4	0,0	33,7
L-Kalishta	92,3	61,3	12,4	0,0	14,5
L-Struga-Black Drin	192,1	220,0	31,8	0,0	26,0
L-Velidab	393,2	97,9	37,1	0,0	89,7
L-Pogradec	485,9	265,6	101,2	20,7	43,5
L-Udenisht	281,3	146,1	50,6	0,0	30,4
L-Lin	255,7	119,5	40,5	0,0	39,1
R-Sateska 1	575,4	482,2	214,8	65,6	99,7
R-Sateska 2	137,8	21,7	34,3	6,8	59,8
R-Sateska 3	202,9	16,8	4,4	0,3	39,9
R-Koselska 1	0,0	181,4	1,0	0,0	22,4
R-Koselska 2	719,4	169,8	69,0	1,5	179,4
R-Sushica	375,6	134,5	49,1	0,1	148,0
Cerave	1078,2	502,1	198,7	22,3	104,3
AWB_Stud Kanal	8,8	0,0	8,7	0,0	9,0
TOTAL	**4841,7**	**2446,1**	**876,0**	**117,1**	**939,6**

Other important aspects related to animal farming are the quantities of manure produced and its management. The quantities of manure produced per year within the LOW for each animal category converted into AU are presented in Fig. 4.7.

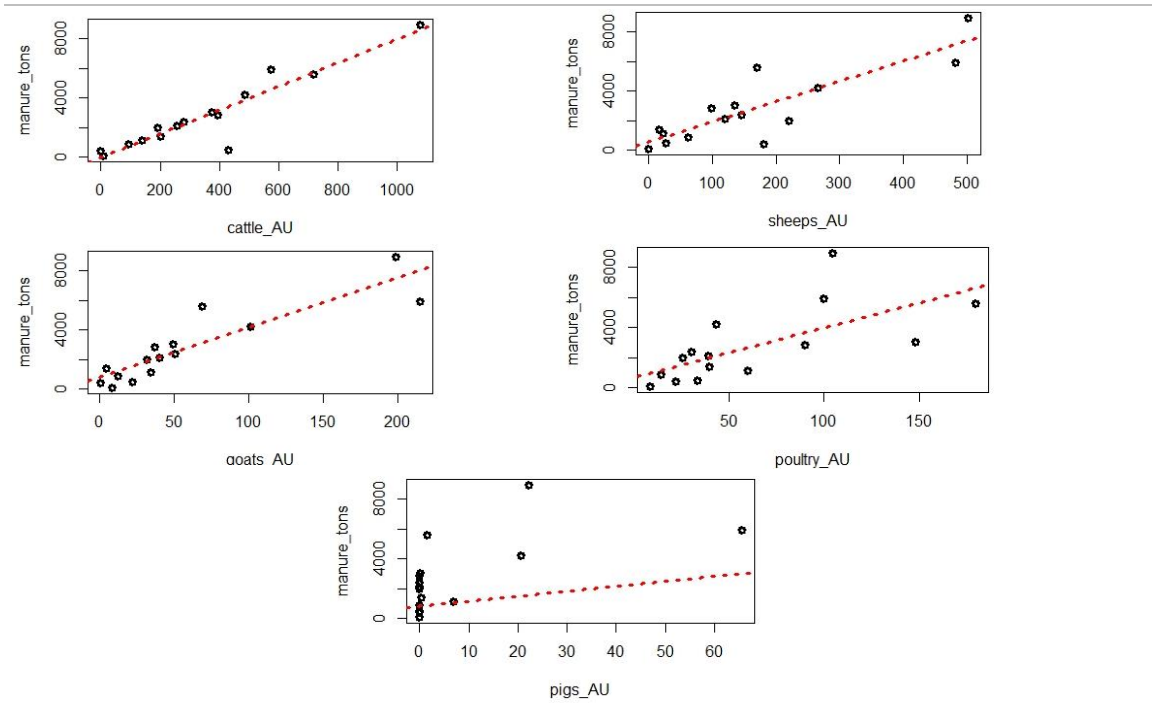

Figure 4.8: Correlation between Manure Production and AU of each Animal Category

The highest content of manure production is in WB Sateska 1 (5,909 t/year) and Koselska 2 (5,612 t/year) on the North Macedonia side and Çeravë (8,962 t/year) in Albania, which is result of the high number of cattle and sheep in these WB.

Application of manure on arable land is a fundamental measure for maintenance of the soil organic matter content. However, the quantities of produced manure are limited and insufficient to meet the actual requirement of arable land in the basin area. Another obstacle which affects the efficiency of the already limited quantities of manure is the inappropriate way of management. During the field visits it was observed that farmers in the basin do not practice proper storage of manure and its application. In many cases it is stored on open space uncovered for few months, or left as a small clumps in the field before being scattered and incorporated in the soil with ploughing. Until than the majority of nutrients are lost, and the efficiency of such managed manure is almost zero.

4.6 FISHERY AND AQUACULTURE

Overview of fishery and aquaculture activities/sectors in the LOW, as well as the pressures on water resources and biodiversity created by these activities, is provided further; detailed analysis is included in Supplement V.

4.6.1 Exploitation – commercial and recreational fishing

Although Fishery Master Plan for Lake Ohrid exists on both sides of the lake, adequate fish catch survey, in terms of catch structure (size, weight, age and sex) indicating the main determinants for controlling and proper protection of fishes in the lake, is lacking.

This is mainly a concern for the endemic Salmonid species in the lake – Ohrid Trout and Belvica – that are the main market demanded fish species. Adding poaching (illegal fishing), the pressure to these fishes has increased to a level of possible irreversibility of their populations.

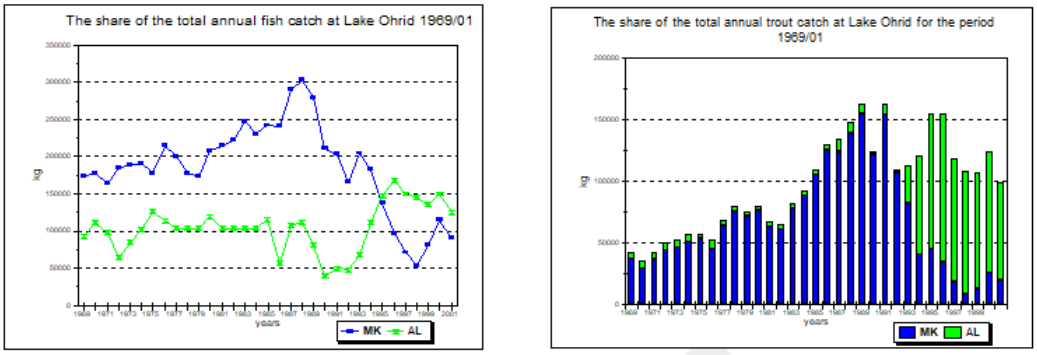

Figure 4.9: hare of Total Annual Fish and Annual Trout Catch at Lake Ohrid, 1969 – 200135

Despite the vast efforts in restocking of the lake with offspring of Ohrid Trout, which takes part every year on both sides with roughly 3,500,000 individuals for the whole lake, inadequate protection and unsustainable fishing practices are pushing towards inevitable further population destruction of these two fish species.

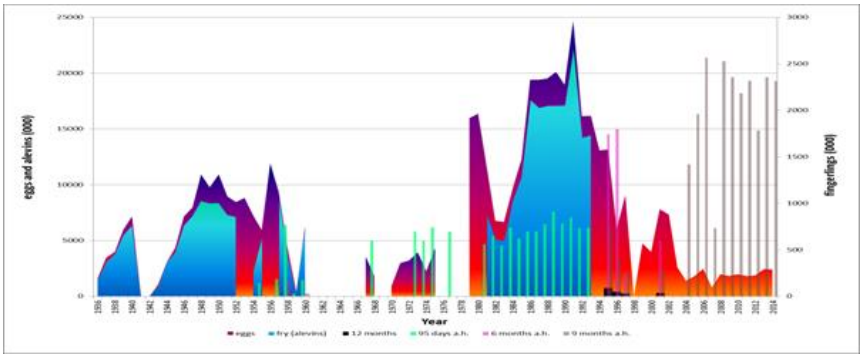

Figure 4.10: Lake Ohrid trout restocking on the North Macedonia side of the lake36

Lake Ohrid has in the past has been described as salmonid water. Yet, recent findings show that the lake is dominated by cyprinid species, both in terms of numbers and biomass. On the other hand, the destruction of salmonid species favors the bleak (small fish with biggest abundance in the lake), which in shortage of trout as a predator spreads all over the lake spatially and temporally, invading new ecological niches in the lake (e.g. pelagic) previously reserved for the trout. Thus, the common nutritive component for these two fish species – the zooplankton – becomes more affordable for the bleak unlike previously for the trout. Further, the misbalanced trout:bleak ratio also contributes to worsening of the water quality, in particular due to increased presence of excretive metabolites from the bleak that differ from the trout ones. Hence, very low exploitation of the bleak is just worsening the ecosystem characteristics.

Table 4.5: LOW: Commercial Fish Catch 2010 - 2016

Lake Ohrid - Fish Species and Catch (t)																
Fish species	Albania					North Macedonia					Total					%;
Common name	2010	2011	2012	2013	2014	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016	(2014)
Lake Ohrid trout	51.0	52.0	50.5	50.0	51.8	0.2	0.9	1.1	0.7	0.3	50.7	50.9	52.9			28.9%
Belvica	12.0	11.0	11.7	12.0	12.5	1.0	8.0	14.7	17.1	17.4	12.7	20.0	27.2			14.9%
Carp	5.0	4.4	4.2	4.0	4.9	3.6	14.3	21.7	11.3	5.2	7.8	18.3	26.6			14.6%
European eel						0.2	1.1	1.1	0.2	0.0	0.2	1.1	1.1			0.6%
Bleak	57.0	55.0	54.9	58.0	56.1	3.6	5.0	5.7	0.0	0.1	58.5	63.0	61.8			33.9%
Roach						0.0	0.6	0.0	0.0	0.0	0.0	0.6	0.0			0.0%
Chub	4.8	5.7	5.0	4.2	6.5	0.5	3.1	3.1	1.1	0.9	5.5	7.3	9.6			5.3%
Rudd						0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0			0.0%
Barbel						0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0			0.0%
Prussian carp	2.7	2.9	3.4	3.0	3.2	1.0	0.4	0.3	0.0	0.0	4.4	3.4	3.5			1.9%
Total (t)	132.5	131.0	129.7	131.2	135.0	10.1	33.4	47.6	30.7	23.9	139.8	164.6	182.6	0.0	0.0	100%

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[35] Source: Spirkovski at all., 2002.

[36] Source: HBI Ohrid Statistics.

4.6.2 Introduced Species and Diseases

There are six introduced (alien) fish species in Lake Ohrid at the moment. During the performance of Lake Ohrid fish and fisheries monitoring program 2013/2015 the following situation was registered. The absence of the other four alien species is a result of used sampling (fishing) method, period of sampling and their very low abundance, yet there are sporadic evidences of their presence. At any rate, the two key alien fish species in the lake (stone moroko and the bitterling; Table 4.6) have already established stable population size and can be stated without significant harm to the native species.

Table 4.6: LOW: Registered Alien Species

Species Latin name	Species common name	Alien species (year of introduction)
Carassius gibelio	Prussian carp	+ (1983)
Gambusia holbrooki	Mosquito fish	+ (1940's)
Lepomis gibbosus	Pumpkinseed	+ (1990's)
Oncorhynchus mykiss	Rainbow trout	+ (1974)
Pseudorasbora parva	Stone moroko	+ (1970's)
Rhodeus amarus	Bitterling	+ (1990's)

4.6.3 Abstraction of surface water and diffuse pollution from aquaculture

At present abstraction of surface water for aquaculture takes place at the two hatcheries (trout restocking fish farms) in Ohrid (HBI) and Lin, as well as at three small fish farms on the Albanian part of the lake. The total extracted water volume equals roughly 2.5 mill m^3/year.

Diffuse pollution from aquaculture, although at a minimal level, is a result of the presence of both restocking fish farms in Ohrid (HBI site) and Lin. The amount of food (nutrient load) used for these fish farms is minimal, at roughly 3,000 kg/year at each site. There are no other fish farms (cages) in the lake at present. On the other hand, diffuse pollution from other activities (e.g. agriculture) expressed in agrochemical load in the lake affects the fish fauna in various manners. Of particular importance in this regard is the presence of pesticides and herbicides, which harm the fish physiology, result in metabolism changes and worst in genetic changes – masculinization or feminization of the opposite genders.

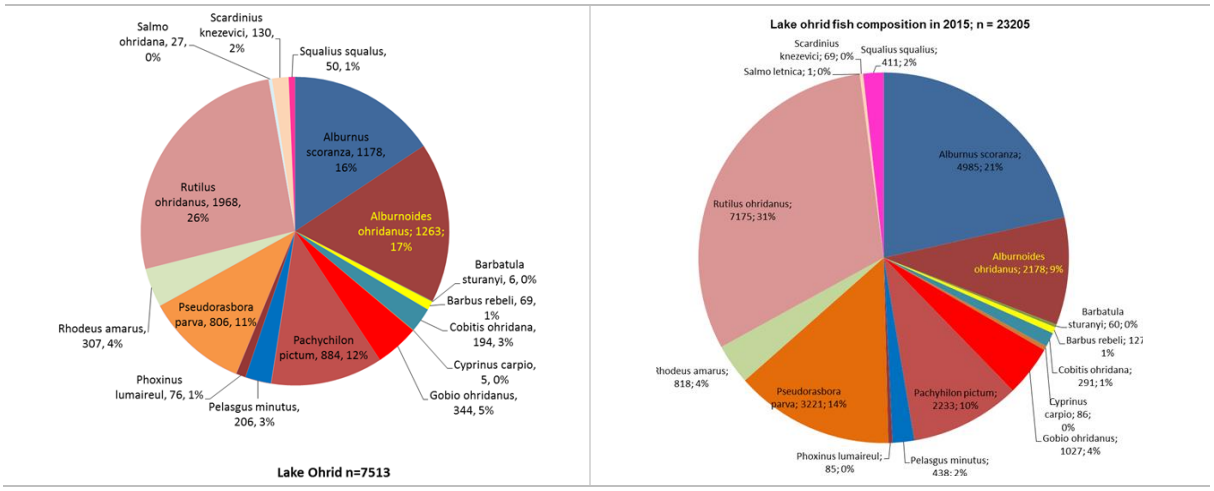

Figure 4.11: LOW: Fish Species Composition in Lake Ohrid, 2013 and 2015 Sampling Campaigns

4.7 COMMERCIAL AND LEISURE BOATING, ANGLING

Cruising and boating are important recreational and tourism activities in Lake Ohrid and commercial boating is an economic activity of importance for the local population. Based on information given by the Port Authority in Ohrid, there are two types of watercrafts used in Lake Ohrid: recreation and/or fishing boats (smaller vessels with length up to 12m, largely for personal use) and larger water taxi (sightseeing/passenger) boats used for public transport. There are a total of 2,268 recreation and fishing boats registered by the Port Authority since 1999, of which 500-600 of these are in regular use at present, and 4 sightseeing boats in use on the North Macedonia part of the lake. Nevertheless, it is also reported that some 40-50 private recreation boats are in use for transport of passengers on commercial basis. Data on the boats in use on the Albanian side of the lake are not available; it is estimated, however, that there are not more than roughly 200 small boats used for recreation and fishing.

Summary information on the commercial boat transport on Lake Ohrid is given in Table 4.7[37].

Table 4.7: Commercial Boat Transport in Lake Ohrid (North Macedonia)

Lake Ohrid boat transport	2014	2015	2016	2017	2018
Number of passenger boats	4	4	4	4	4
Capacity (passengers)	530	530	530	530	530
Total annual number of passengers	36,620	38,685	30,430	44,510	46,590
Total number of passenger kilometers	741,000	875,000	898,000	1,007,000	1,082,000
Average km/passenger	20	23	29	23	23

Cruising and boating can give rise to localized water problems including discharge from onboard toilets, physical disturbance by boat wakes and potential engine-oil spillage. Besides, leisure boating by violating the inland water navigation regulations causes additional stress and disruption of the fish ecology especially in the natural spawning period and the spawning grounds. Also, using boats and speedboats for poaching during the spawning period further worsens the situation.

Nevertheless, the biggest problem related to cruising and boating is the lack of proper infrastructure for docking and servicing used watercrafts. As a matter of fact, on the North Macedonia part of the lake there are only two ports that can be used for docking of passenger boats: a relatively small boat port in the very center of the town of Ohrid, and even a smaller one on the other side of the lake at St. Naum. In addition there are some 15 docking stations along the shoreline that are used by the private recreation and fishing boats. Thus, majority of the boats currently in use are forced to use the AWB Studenchishki kanal as a docking station (Fig. 4.12). However, besides lack of capacity, the 'kanal' is also not equipped with even elementary infrastructure and facilities for refueling and servicing of boats. The situation on the Albanian part of the lake, albeit the pressure from cruising and boating is much lower, is similar.

Figure 4.12: Boat Docking at Studenchishki Kanal Near Ohrid

Angling at present is reduced only to shoreline fishing and fishing from boats in the littoral zone, which is a result of the reduced trout population in the lake, contrary to the situation until the late 1990-ties when it was the main way of recreational fishing – spinners hook trawling for the local population as well for tourists. Thus, at present no threats of angling are deemed significant, with exception of poachers dealing with non-allowed fishing gears and methods (electricity, spears, scratch hooks).

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[37] Source: State Statistical Office of North Macedonia (2019).

4.8 FLOOD PROTECTION

4.8.1 Physical/Hydromorphological Alteration of Water Bodies

Floods are among the most challenging and recurring natural hazards in the LOW. River floods occur mainly in spring and autumn. Autumn floods resulting from heavy rainfalls are more sudden and have very high flows. Flash floods are common in mountain areas. Further, Climate change is forecasted to increase both the frequency and intensity of flooding and droughts in the basin. Shifting weather patterns will likely result in warmer and wetter winter seasons that could result in increased flood risks. Although an overall decrease in total precipitation is expected, a higher frequency of extreme weather conditions are expected, causing floods and pollution of waters as a consequence of soil erosion. The pressure can even be further intensified having in mind that soil erosion is also a consequence of overlogging and overgrazing practices in the LOW.

The following sources of flooding occur in the LOW:

- ✓ pluvial (surface water) flooding when run-off from the surrounding area exceeds the flow capacity of the rivers, streams or the artificial drainage system (Sateska, Koselska, Çeravë River);
- ✓ torrential foods, which are combination of high water discharge and mass movement moving through the channels of the streams, leading to transport of large volumes of sediment and debris (Sushicka, Vërdova, Gështenjas and Hudënisht and other torrential rivers);
- ✓ coastal flooding, in coastal areas in Ohrid and Struga, during extreme weather and high tides cause a rise in lake levels resulting in coastal flooding;
- ✓ groundwater flood especially in the region of Struga. In conditions of high water level in valleys such as the Ohrid-Struga, the level of underground water rises to the surface of the terrain and the frequent occurrence of flooding of the terrain is characteristic; and
- ✓ drain and sewer flooding in urban areas.

Table 4.8 provides an overview of hydromorphological modifications/alterations of water bodies in the LOW for purposes of lowering flood risk.

4.9 ENERGY - HYDROPOWER

Water resources of the LOW are also used for hydropower generation. A total of five small hydro power plants (SHPP) are identified in the North Macedonia part of the basin (Fig. 4.12; Map 14), with installed capacity ranging from 0.2 to 0.6 MW[38]. The plants create an impact on the water body ecological status/potential (flow regime) on AWB: Studenchishki kanal and WBs Koselska 2, Sushica and Sateska 1.

Table 4.8: LOW: Flood Protection Infrastructure

River/WB	Regulated length (km)	Capacity (m^3/s)	Return period	Probability	Description
L-Struga-Black Drin	0.9	130	Q100	1%	Major and minor river bad with concrete walls
R-Koselska 2	0.4	NA	NA	NA	
R-Sateska 3	6.9	100	Q100	1%	Earth embankments
L-Pogradec	1.0	NA	NA	NA	Concrete

Apart from the SHPPs located within the LOW boundaries, waters draining from the lake into the Drin River feed a series of seven large cascade hydropower plants (HPP) along the flow to the Adriatic Sea: HPP Globochica and HPP Shpilje in North Macedonia; HPP Fierzë, HPP Komanit, HPP Vau I Dejës and HPPs Ashta 1 and Ashta 2 in Albania (Fig. 4.13). The combined installed capacity of the seven HPPs equals 1,520 MW, and the total annual electricity generation by the plants in 2015 equaled 5,230 GWh (4,700 GWh by HPPs in Albania and 540 GWh by HPPs in North Macedonia)[39]. Over 80% of the total power produced in Albania in 2015 was from HPPs in the Drin basin. Waters from the LOW account for roughly 70% of the electricity generated by the two HPPs in North Macedonia, and 7%-8% of the total electricity generated by the HPP cascade on Drin River.

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[38] Source: Energy Agency of North Macedonia (http://North.ea.gov.mk)

[39] Source: "Thematic Report on Socio-Economics of the Extended Drin River Basin; The Global Water Partnership – Mediterranean (GWP – Med), November 2017.

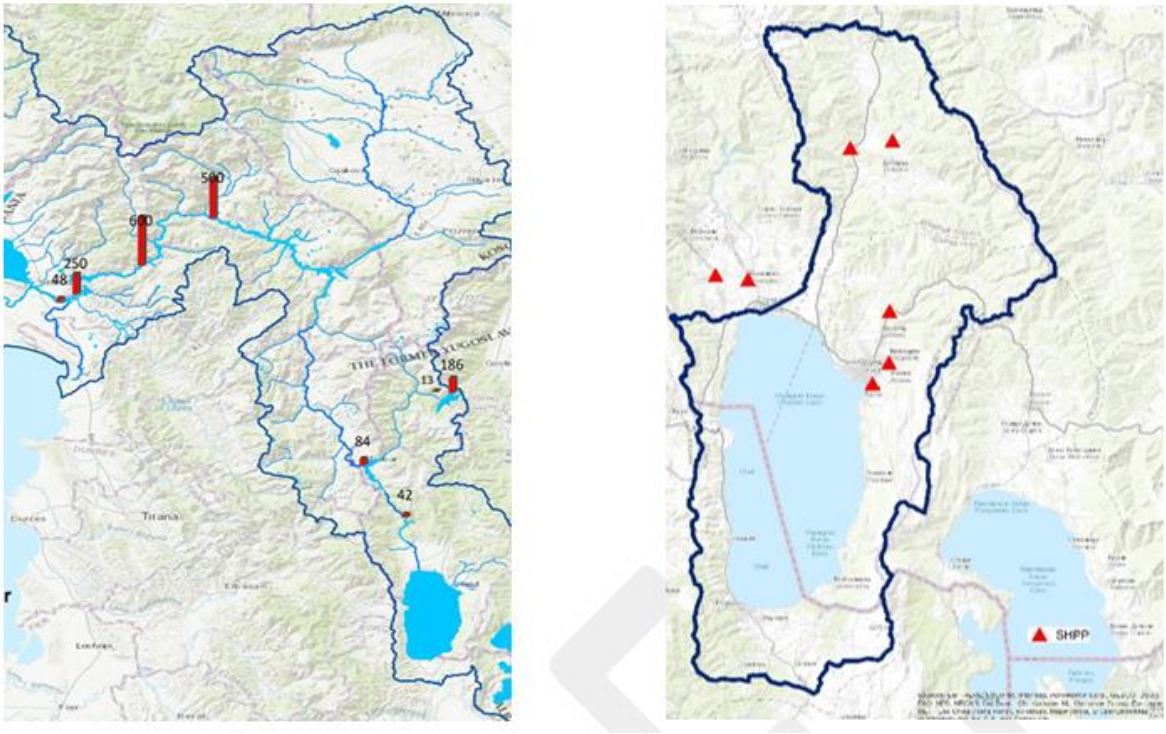

Figure 4.13: Hydropower Plants Fed by Water Resources of LOW – Wider Drin River Basin and LOW

4.9.1 Hydrological/Physical Alteration of River Bed (Sateska River)

A specific aspect related to hydropower generation in the LOW is the diversion (physical alteration) of the flow of Sateska river. Namely, in 1961/62 a 7-km artificial channel had been constructed that enabled the flow of Sateska river, which previously (physically) drained directly into Black Drin (Fig. 4.14), to end up in Lake Ohrid. The key goals of the rerouting was to: protect the regulated flow of Black Drin river from sediments coming from Sateska, use the lake volume for balancing of Sateska water flow (through the controlled outflow in Black Drin River in Struga) for electricity production on the Drin cascades in North Macedonia, and flood protection.

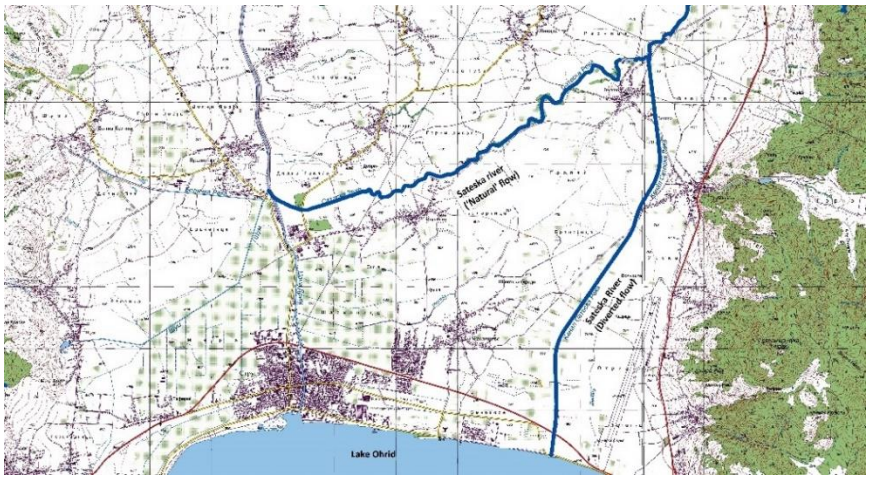

Figure 4.14: Sateska River – Natural and Diverted Flow

The average inflow of waters from Sateska river into Lake Ohrid equal 5.5 m^3/sec, and the rerouting of the river increased the LOW area for 35% to 40%. In addition, various authors in different documents have evaluated the total amount of transported sediment since the diversion, where values range from 108,000 m^3/year to 128,000 m^3/year. However, based on information from the HBI in Ohrid the average daily discharge of sediments from Sateska into the lake equals up to 130 m^3. Thus, according to bathymetric analysis of the lake bottom from 1994, estimated transported sediment volume equals 48,760 m^3/year, which for the past period of 55 years amounts to nearly 3 mill m^3 of deposited sediment in the lake.

This constant, long-term input of suspended matter have created severe changes of the littoral zone of the lake, forming sandy deposits which at a lower water level create visible 'islands' near the influx area (Fig 4.15). Thus, the natural heterogeneity of the bottom is profoundly transformed into uniform sandy habitat, which further results in absence of aquatic vegetation and fauna commonly present in other littoral parts of the lake.

Figure 4.15. The Inflow of (Diverted) Sateska River in Lake Ohrid

Further, the inflow of Sateska river is the main source of phosphorus in the lake, with an estimated amount of 39% of the total phosphorus inflow from tributaries, and the second largest source of nitrogen (29% of the total nitrogen inflow). The inflow of phosphorus and nitrogen represent a huge pressure for eutrophication of the lake waters. In addition, the inflow of Sateska river represents a 'corridor' for input of invasive species in the lake.

4.10 WATER BALANCE

As reported in Section 2.1, Lake Ohrid is hydrogeologically connected to the nearby Lake Prespa, which sits at an elevation of roughly 150 m higher than Lake Ohrid. The two lakes are separated by the Galichica and Suva Gora mountains, which consist of karstified limestone through which water from Lake Prespa is draining into Lake Ohrid (Fig. 4.15). This makes Lake Prespa one of the main sources of inflowing waters into Lake Ohrid.

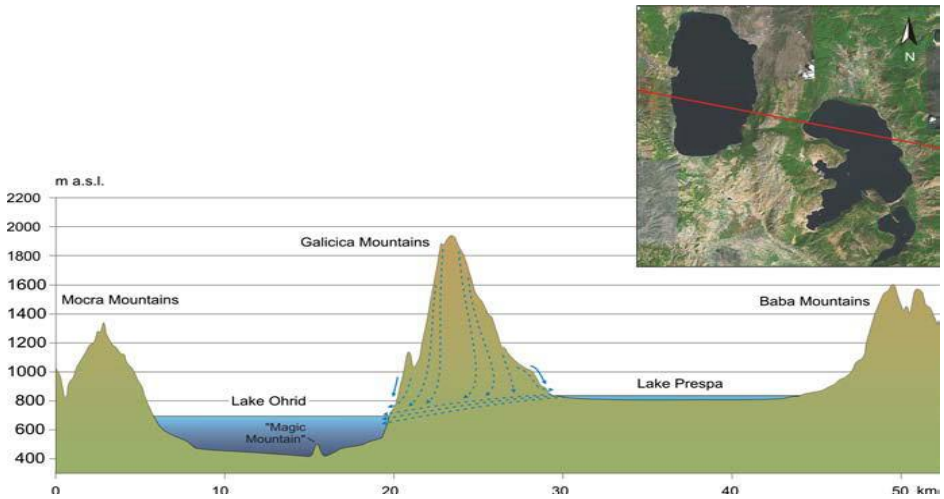

Figure 4.16: The Underground Karstic Connection between Lake Prespa and Lake Ohrid[40]

Apart from the springs, important volume of water drains in Lake Ohrid through a number of tributaries, most of which are small creeks that flow only temporarily during snowmelt and heavy rain periods. The main rivers in the LOW, tributaries to Lake Ohrid (Map 1), include: Sateska, Koselska, Shushica and Grashnica river in North Macedonia, as well as Çeravë and Verdovë rivers in Albania.

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[40] Adopted from [38]

Water from Lake Ohrid outflows into the Black Drin River at the town of Struga, flowing northwards on the way to the estuary in the Adriatic Sea. Since 1962 the river's outflow has been controlled with a weir, which regulates the water level. Based on agreements between Albania and the former Yugoslavia, since 1979 the minimum water level in Lake Ohrid is set at 693.10 masl and the maximum level at 693.75 masl, resulting in annual fluctuations of the level in the range of 0.65m.

4.10.1 Water Budget

The analysis is based on the following assumptions:

- ✓ 20-year period (1978 – 1998) for which historical input data for all parameters are available that enable compatibility and comparability of the results with other analysis;
- ✓ the analysis is on monthly basis;
- ✓ input of water into the lake based on:
  - measured discharge from rivers (where applicable) and correlated for other streams,
  - precipitation in the watershed,
  - discharge from springs (Lake Prespa);
- ✓ output from the lake:
  - evaporation from the lake surface area,
  - transpiration of water from other parts of the basin (forests),
  - abstractions for water supply,
  - outflow from the lake based on measurements in MS Lozhani;
- ✓ control of results based on measured outflow and water-level fluctuations in the lake.

Based on this, the annual inflow of water of 988 million m^3 is nearly equally reliant on input from rivers, precipitation and discharge from springs/Lake Prespa. On the other hand, two-thirds (66.6%) of the output of water from the watershed is through the outflow in Black Drin river and one third from evapotranspiration (Table 4.9). Further, 54% of the sum of inflow from tributaries is from Sateska, roughly 12% from Koselska, and the remaining 34% from all other rivers. The inflow from precipitation nearly equals the outflow from evapotranspiration in the watershed. The annual volume of water abstractions for water supply is less than 1% of the available inflow[41].

Table 4.9: LOW: Water Budget

Water Budget Component	Inflow			Outflow		
	Average (m3/sec)	Annual (m3*10^6)	%	Average (m3/sec)	Annual (m3*10^6)	%
Sateska river	*5.49*	*173.2*				
Koselska river	*1.19*	*37.7*				
Other rivers	*3.50*	*110.5*				
Sum Rivers	10.19	321.3	32.5%			
Precipitation	10.25	323.1	32.7%			
Prespa/springs Inflow	10.91	344.1	34.8%			
Black Drin				20.89	658.9	66.7%
Transpiration/Evaporation				10.16	320.5	32.4%
Water supply				0.28	8.7	0.9%
Total	**31.35**	**988.5**	**100%**	**31.33**	**988.1**	**100%**

4.10.2 Long-term Water Balance and Lake Ohrid Water-Level Fluctuations

As indicated before the outflow from Lake Ohrid is controlled with a weir, which regulates the water level in the lake within the agreed elevations of 693.10 masl as a minimum and 693.75 masl as a maximum, resulting in annual fluctuations of the level in the range of 0.65m. Therefore, since the outflow is controlled, the annual fluctuations of the water level do not directly reflect the long-term variations of water inflow into the lake. On the other hand, the analysis of the monthly cumulative precipitation anomalies for the watershed (Section 2.1; Fig. 2.6) clearly determine the positive and negative phases in precipitation variability, with an observed major drought event over the 1986/7 to 1995/6 period. Further, apart from precipitation variances within the LOW territory, the long-term variations of water inflow from the karstic springs (Lake Prespa) have also not been adequately ascertained.

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[41] Water withdrawals for irrigation directly from the lake are uncommon; irrigation withdrawals from rivers and groundwater are included in the analysis through the (reduced) inflow from tributaries.

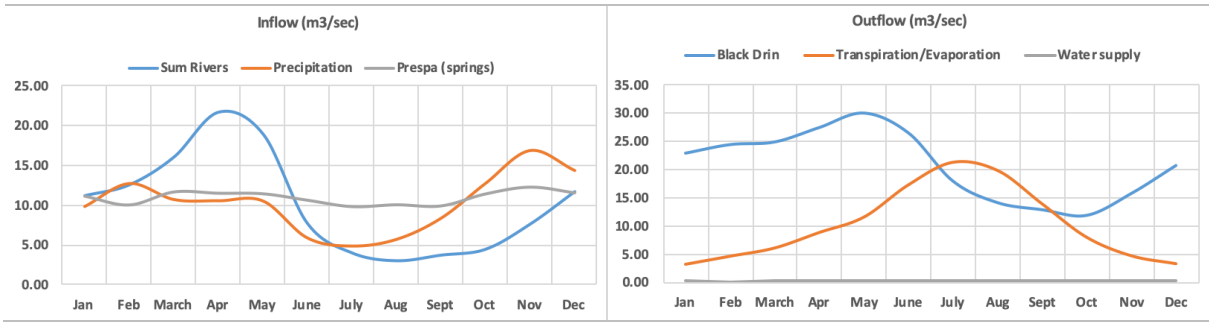

Figure 4.17: Average Monthly Inflow and Outflow of Water from Lake Ohrid (1978-1998)

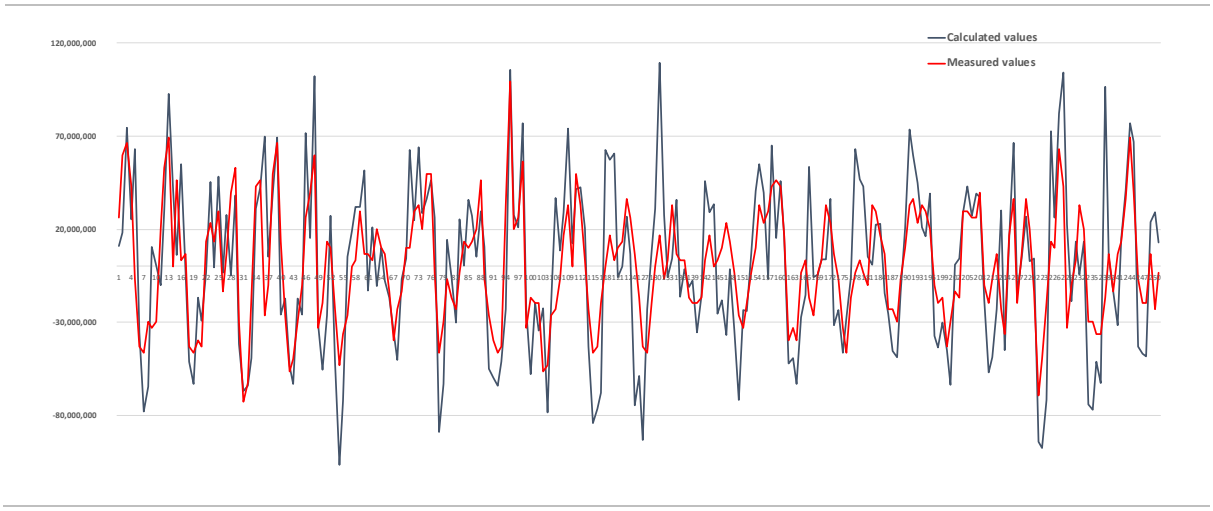

Figure 4.18: LOW: Monthly Water Balance (1978 – 1998)

The long-term monthly water balance of the LOW was modelled through the use of empirical and stochastic methods to simulate the variations in the input parameters (e.g. precipitation, evapotranspiration, irrigation withdrawals within the basin, possible irrigation/groundwater withdrawals from contiguous agriculture areas around Struga which are fed by water from the lake, inflow from Lake Prespa, etc.) and their correlation with available documented data for water outflow and water-level variations. Summary results are presented on Figure 4.18: LOW: Monthly Water Balance (1978 – 1998), Figure 4.19. Discharge from Lake Prespa to Lake Ohrid and Lake Prespa water-level fluctuations (1978 – 1998), Figure 4.20: Monthly Water-Level Fluctuations (1978 – 1998).

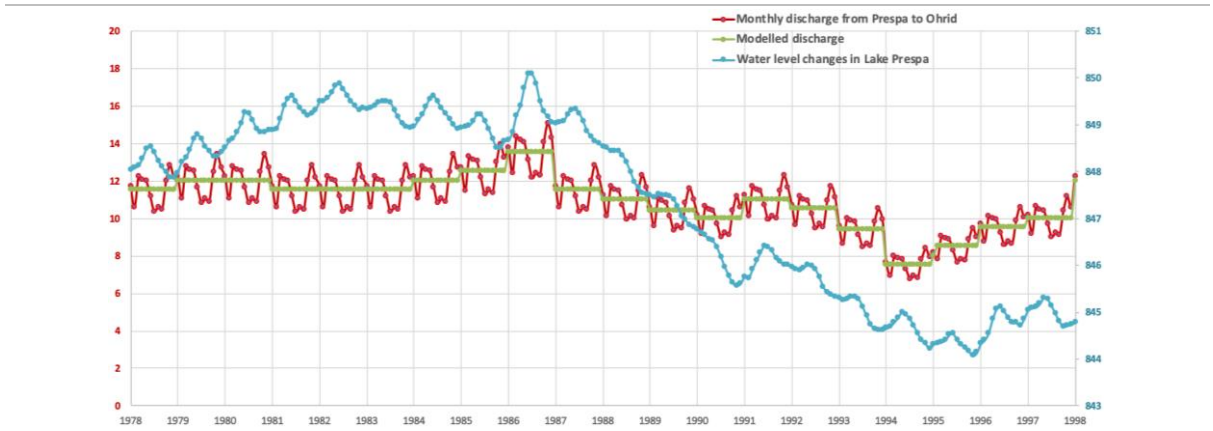

Figure 4.19. Discharge from Lake Prespa to Lake Ohrid and Lake Prespa water-level fluctuations (1978 – 1998)

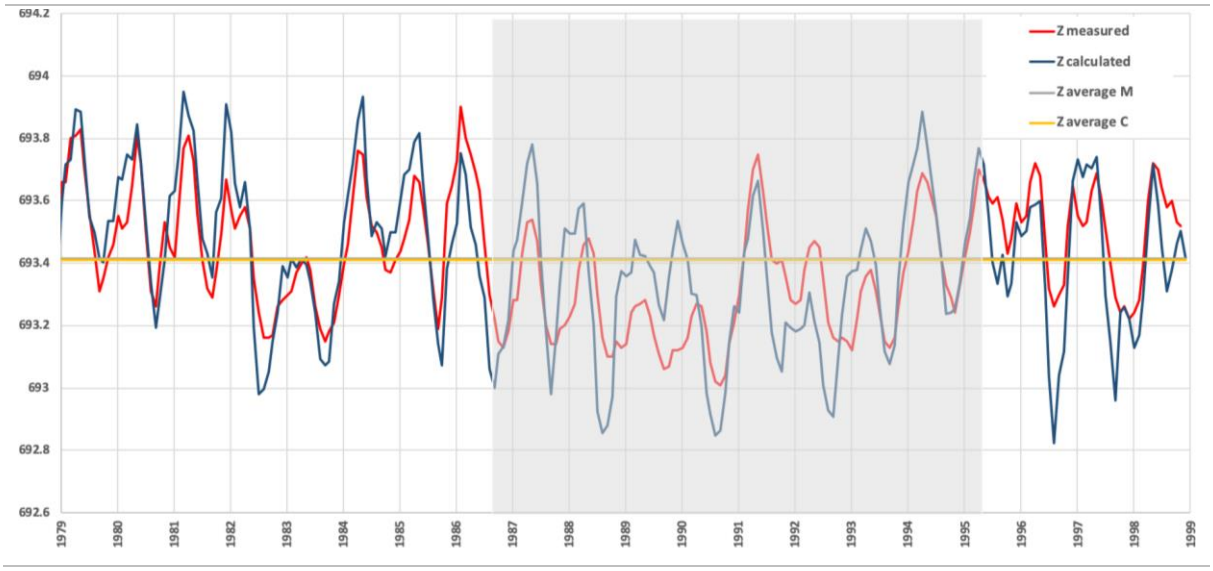

Figure 4.20: Monthly Water-Level Fluctuations (1978 – 1998)

Several observations and conclusions arise from the analysis:

- ✓ as a result of the hydrological system's complexity, the model is highly sensitive to practically all input parameters;
- ✓ in spite of the importance and continuous focus of the broader scientific community for the basin, there is a serious gap in the availability and reliability (consistency) of measured data that would enable precise modeling of the LOW hydrological specifics, thus also for use of the model for projection of potential future outcome variations that may arise as a result of changes in the input parameters, which is an aspect that needs to be addressed instantly;
- ✓ of particular importance in this regard is the need for conducting analysis aimed at precise determination of the 'link' between Lake Prespa and Lake Ohrid. It is evidenced that the climate/hydrology/water-level variations in the Lake Prespa basin result in important oscillations of the inflow of waters from Prespa into Ohrid, however the expected result-accuracy is lacking. This, in particular, is of essence for projection of potential adverse effects of future draught periods in the region on the water balance of Lake Ohrid;
- ✓ the controlled (regulated) outflow from Lake Ohrid, which enables water-level fluctuations within the 0.65m to 0.75m range throughout the year, undoubtedly has highly positive effects on preservation of basin's hallmarks of – biodiversity/endemism hot-spot and tourism attractiveness; and
- ✓ given the availability of water resources, which embraces both the volume of Lake Ohrid (58 km^3) and the annual water inflow volume (988 mill m^3), water abstractions from the basin (including withdrawals for drinking plus industry water supply and irrigation) do not represent a serious threat to its water balance.

4.11 SUMMARY OF PRESSURE TYPES IN LOW

Table 4.10 below provides an overview of the pressure types and drivers according to WFD Reporting Guidance 2016.

Table 4.10: LOW: Summary of Pressures on Water Resources

Pressure	Driver	Indicators	Index	Affected WBs
1.1 - Point – Urban waste water	Urban development	Load of BOD to be reduced (in tonnes/day) to achieve objectives	2.97 (t/day)	[1] [2] [6] [7] [10] [18] [19]
		Load of nitrogen to be reduced (tonnes/day) to achieve objectives	TBD	
		Load of phosphorus to be reduced (tonnes/day) to achieve objectives	TBD	
		Number of water bodies failing EQS for RBSP	12	
1.2 - Point – Storm overflows	Urban development	Number of urban areas with excessive overflows that are causing or contributing to failure of objectives	3 larger cities + 30 other settlements	[1] to [20]
		Number of water bodies failing EQS for PS and/or RBSP	11	
1.3 - Point –Non-IED plants	Industry	Number of permits not compatible with the achievement of objectives	14	
		Number of water bodies failing EQS for RBSP	14	
1.6 - Point – Waste disposal	Urban development	Number of waste disposal sites affecting achievement of objectives	2(+2) official landfills 20 illegal dumps	[1] to [20]
		Number of water bodies failing EQS for PS and/or RBSP	14	
1.8 - Point - Aquaculture	Fisheries and aquaculture	Number of point sources affecting achievement of objectives	2 hatcheries + 3 small fish farms	[6] [19]
2.1 - Diffuse - Urban runoff	Urban development	Length (km)/area (km^2) of water bodies that are not achieving objectives because of diffuse urban run off	320 km^2	[3] [5] [6] [7] [10] [12]
2.2 - Diffuse – Agricultural	Agriculture	Load of nitrogen to be reduced (in tonnes) to achieve objectives	TBD	[3] [4] [6] [7] [10] [11] [12] [14] [15] [18] [19] [20]
		Load of phosphorus to be reduced (in tonnes) to achieve objectives	TBD	
		Number of water bodies failing EQS for pesticides originating from diffuse agricultural sources	12	
		Number of farms not covered by advisory services	TBD	
		Area of agricultural land at risk of soil erosion	TBD	
2.5 - Diffuse – Contaminated or abandoned industrial sites	Industry	Area of land (ha) under pressure that needs to be subject to measures	20 ha	[11]

Pressure	Driver	Indicators	Index	Affected WBs
2.6 - Diffuse – Discharges not connected to sewer network	Urban development	Length (km)/area (km^2) of water bodies not achieving objectives because of this pressure	47.5 km	[1] [7] [11] [12] [19]
2.9 - Diffuse – Aquaculture	Fisheries and Aquaculture	Length (km)/area (km^2) of water bodies not achieving objectives because of this pressure	5 km	[6] [19]
3.1 - Abstraction or flow diversion – Agriculture	Agriculture	Volume of water abstracted/diverted for agriculture (million m^3) to be reduced to achieve objectives	TBD	
3.2 – Abstraction/flow diversion – Water supply	Urban development	Volume of water abstracted for public water supply (million m^3) to be reduced to achieve objectives	8.5 mill m^3/year	[1] to [20]
3.3 - Abstraction or flow diversion – Industry	Industry	Volume of water abstracted for industry (million m^3) to be reduced to achieve objectives	TBD	
3.5 – Flow diversion – Hydropower (Sateska river)	Energy – hydropower	Volume of water diverted (million m^3) to be reduced to achieve objectives	187.5 mill m^3/year	[13] [15]
		Volume of sediment to be reduced to achieve objectives	34,150 m^3/year	
3.6 - Abstraction or flow diversion - Fish farms	Fisheries and Aquaculture	Volume of water abstracted for aquaculture (million m^3) to be reduced to achieve objectives	1.75 mill m^3/year	[6] [19]
4.1.1 - Physical alteration of channel – Flood protection	Energy – hydropower Flood protection	Length (km) of water bodies affected by alterations for flood protection not compatible with good ecological status/potential	9.2 km on river WBs 5 km along the Lake	[3] [6] [10]
5.1 - Introduced species and diseases	Fisheries and aquaculture	Number of introduced species preventing the achievement of GES/GEP	6 species	[1] to [12]
5.2 - Exploitation or removal of animals	Fisheries and aquaculture,	Length (km) /area (km^2) of water bodies where the exploitation of animal is preventing the achievement of good ecological status/good ecological potential	356 km^2	
5.3 – Litter or fly tipping	Urban development,	Length (km) of water bodies impacted by litter or fly tipping	All Lake WBs 65 km of RWBs	[1] to [12] [5] [14] [15] [19] [20]
7 – Anthropogenic pressure – Other (boating)	Tourism and recreation	Length (km) /area (km^2) of water bodies where other anthropogenic pressures are causing the non-achievement of objectives	356 km^2	All Lake WBs

[1]	L-Radozhda	[6]	L- Studenchishki kanal	[11]	L-Udenisht	[16]	R-Sateska 3
[2]	L-Kalishta	[7]	L-Velidab	[12]	L-Lin	[17]	R-Koselska 1
[3]	L-Struga-Black Drin	[8]	L-Bay of St. Naum	[13]	L-Lake Ohrid-Pelagic	[18]	R-Koselska 2
[4[	L-Sateska	[9]	L-Tushemisht	[14]	R-Sateska 1	[19]	R-Cerave
[5]	L-Koselska	[10]	L-Pogradec	[15]	R-Sateska 2	[20]	Sushica

5 ECOLOGICAL AND CHEMICAL STATUS/POTENTIAL OF WATER BODIES IN THE LOW

5.1 WFD REQUIREMENTS

The WFD (Annex V) requires classification of surface water bodies through determination of their ecological and chemical status. The ecological status is determined through classification of biological quality element values specified for each surface water category. The estimation should be based on results of direct measurements by an established monitoring system, whereas the system shall utilize particular species or groups of species that are representative of the quality element as a whole. The chemical status for each SWB is determined based on assessed level of compliance with quality standards as defined by Article 16 and Annex IX of the WFD, as well as other EU legislation setting environmental quality standards. The chemical status is also based on results of measurements through the monitoring system. In addition, for heavily modified or artificial water bodies reference to ecological status should be interpreted as ecological potential (Fig. 5.1).

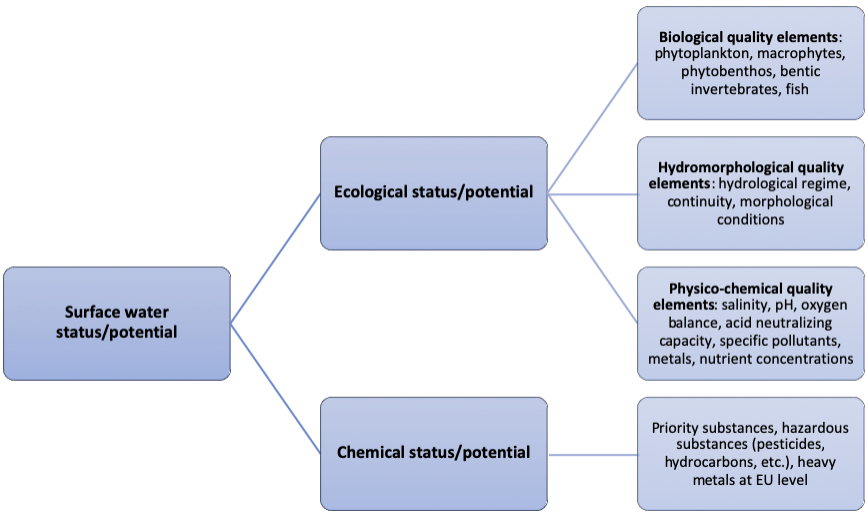

Figure 5.1: Surface Water Status Classification as Defined by the WFD

5.2 EXISTING MONITORING NETWORKS

At present regular monitoring based on the requirements of WFD is not performed in the LOW. In general there are some analyses of water quality performed within the framework of various project. Also two institutions in North Macedonia, more or less regularly analyse few selected parameters. The Institute of public health is responsible for monitoring of drinking water and water for recreation. Based on their program the Institute performes analyses of physico-chemical and bacteriological parameters on 30 sampling site in littoral zone of Lake Ohrid. The frequency of this monitoring is twice per month during summer season and once per month in other seasons. The National Hydrometeorological service is responsible for hydrological network in North Macedonia. In Lake Ohrid watershed two automatic stations for monitoring of water level and temperature are installed and functioning. On the Albanian side regular monitoring is performed on two sampling site.

For ensuring comparability of the classification the results of the monitoring are expressed as Ecological Quality Ratios (EQR), which represents a relationship between the values of observed biological parameter value and the reference condition value of the same parameters for each surface water body.

Ecological Status Classification	Ecological Potential Classification	Chemical Status Classification
High (EQR close to 1)		Good
Good	Good and above	Failing to achieve good
Moderate	Moderate	
Poor	Poor	
Bad (EQR close to 0)	Bad	

Figure 5.2: Ecological and Chemical Status Classes and Colour Codes as defined by the WFD

Finally, the classification based on the EQR is divided in five classes, ranging from High to Bad ecological status. The classification of the chemical status is divided in two classes – Good or Failing to achieve good. The classes of both the ecological and chemical status are also color-coded, as shown on Fig. 5.2.

Evidently the EQR, which is based on comparison of measured biological parameters with reference conditions for the same parameters, is the key factor for determination of the ecological status (classes) of water bodies. Further, type-specific biological reference conditions need to be established for every type of water body representing the values of the biological quality elements for that surface water body type at high ecological status. However, as described also in Section 2.3, Lake Ohrid is a unique ecosystem in the world and trying to find reference conditions in other lakes has no scientific basis. In addition, at present it is practically not possible to establish reference conditions for Lake Ohrid because of two reasons:

- ✓ the presence of high percentage of specific (endemic or relict) species; and
- ✓ limited taxonomical, ecological and biogeographical research of biological quality elements required for proper establishment of reference conditions.

Because of these reasons, the classification of the water bodies of Lake Ohrid is made on the basis of the Carlson's Trophic State Index (TSI), i.e. the US EPA 2000 classification system[42]. The EPA system defines the classification of the trophic status of lake water bodies, thus it differs from the WFD classification. However, the EPA system reflects the primary response (biological activity) of the lake to nutrient overenrichment and therefore represents sound basis for assessing the status of water quality in the lake.

According to the EPA 2000 scheme total phosphorus (TP in µg/l), Chlorophyll-*a* (Chl-*a* in µg/l) concentrations and water transparency (Secchi Disk in m) by using the TSI determine the classification of lakes into six trophic status classes (Table 5.1).

Figure 5.3: LOW: Classification of Lake Water Bodies according to EPA (EPA 2000)

TSI average	SD (m)	TP (µg/l)	Chl-*a* (µg/l)	Trophic status-Attributes
< 30	> 8	< 6	< 0.94	Oligotrophic-Clear water, oxygen throughout the year in the hypolimnion
30 - 40	8 - 4	6 - 12	0.94 – 2.6	Oligotrophic -A lake will still exhibit oligotrophy, but some shallower lakes will become anoxic during the summer
40 - 50	4 - 2	12 - 24	2.6 – 6.4	Mesotrophic-Water moderately clear, but increasing probability of anoxia during the summer
50 - 60	2 - 1	24 - 48	6.4 - 20	Eutrophic-Lower boundary of classical eutrophy: Decreased transparency, warm-water fisheries only
60 - 70	0.5 - 1	48 - 96	20 - 56	Eutrophic-Dominance of blue-green algae, algal scum probable, extensive macrophyte problems
> 70	< 0.25	> 96	> 56	Hypereutrophic, Heavy algal blooms possible throughout the summer, often hypereutrophic

5.3 ECOLOGICAL STATUS/POTENTIAL OF WBs IN THE LOW

For proper determination of the status of water bodies in the LOW a special Surveillance Monitoring Programme was designed and carried out in 2019. The Programme was implemented by a Consortium of specialized research institutions – the Greek Biotope/Wetland Centre (EKBY, part of the Goulandris Natural History Museum, Greece) and the Institute of Marine Biological Resources and Inland Waters (IMBRIW) of Hellenic Centre for Marine Research (HCMR) – and included three monitoring campaigns – February, April and July 2019. The monitoring was carried out at a total of 20 sampling points (Fig. 5.3): 13 lake WBs, 6 river WBs and 1 AWB – Studenchishki kanal. Details from the monitoring are given in a separate consolidated report[43].

Based on results of the Monitoring Programme, but as well on data from previous monitoring and analysis for water bodies that were not included in the Programme (e.g. Sushica river), classification of the ecological status of river

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[42] The use of the EPA classification for Lake Ohrid was also suggested by the Surveillance Monitoring Programme Report; details are given further.

[43] "Final report: Surveillance Monitoring Programme for the Lake Ohrid Watershed" (September 2019).

WBs according to the WFD is shown in Fig. 5.3 and Table 5.2; The classification of lake WBs based on the TSI is presented on Fig. 5.3, Table 5.3 and Map 15.

Overall, 2 river WBs – R-Sateska 1 and R-Koselska 1 – are assessed as having Good ecological status; 3 river WBs – R-Sateska 2, R-Sateska 3 and R-Koselska 2 – as having a Moderate status/potential; 2 rivers/WBs – R-Cerave and R-Sushica – as having Bad status; and the AWB Studenchishki kanal as having Poor status/potential.

Table 5.1: LOW: Ecological Status/Potential of River WBs

Water Body	Ecologocal Status/Potential	WB length (m)	Total river length (m)	WB as % of total river length
R-Sateska 1	GOOD	23,138	40,828	57%
R-Sateska 2	MODERATE	10,727		26%
R-Sateska 3	MODERATE	6,963		17%
R-Koselska 1	GOOD	13,963	33,779	41%
R-Koselska 2	MODERATE	19,816		59%
R-Cerave	BAD	19,940	19,940	100%
R-Sushica	BAD	7,627	7,627	100%
AWB Studenchishki kanal	POOR	625	625	100%

As regards Lake Ohrid, 5 of its WBs are classified as Oligotrophic-Clear water, 6 as Oligotrophic – A, and the remaining 2 lake WBs as Mesotrophic – Water moderately clear status under the EPA system (Fig. 5.3). All water bodies in the basin are assessed as currently having Good chemical status.

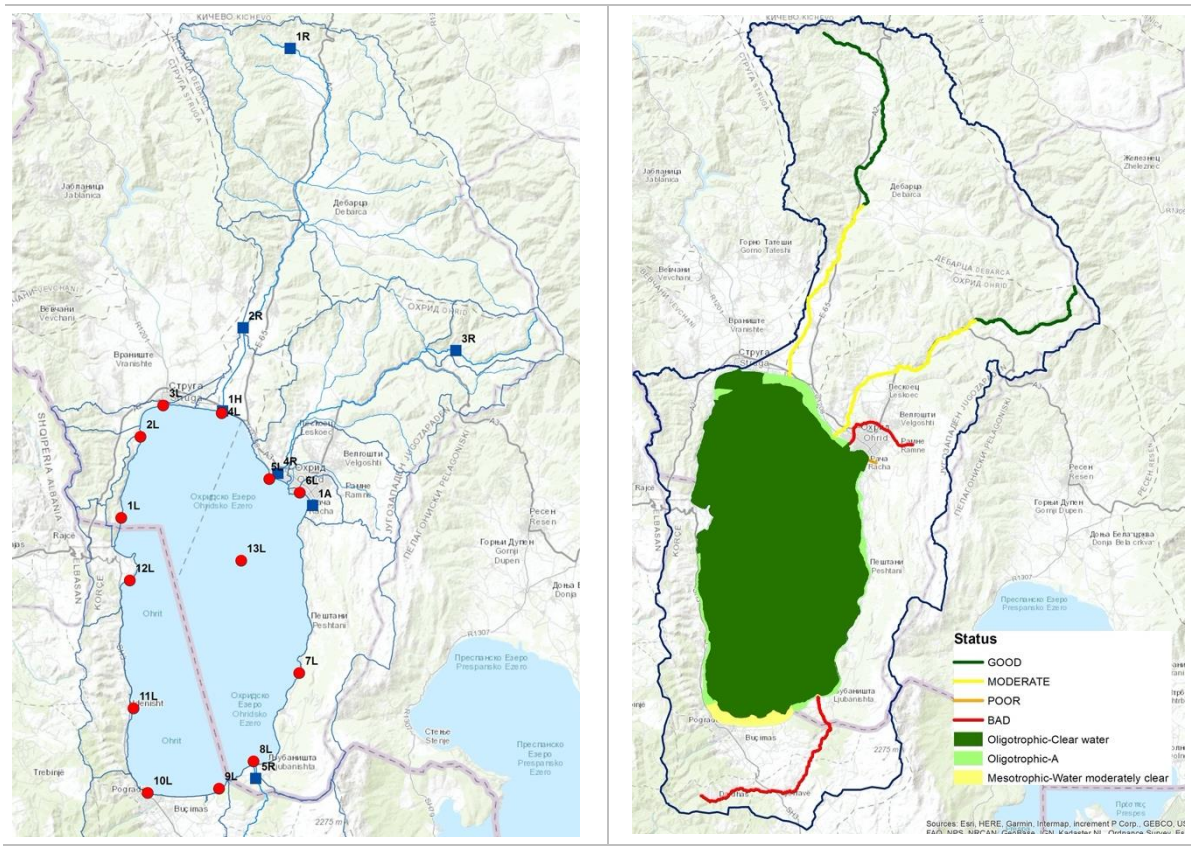

Figure 5.4: LOW: Sampling Sites for the Surveillance Monitoring Programme; Classification of Surface Water Bodies

Table 5.2: LOW: Trophic Status of Lake WBs

No.	Type	WB Name	Trophic Status	Mean TSI
1	L	L-Radozhda	Oligotrophic-Clear water	28.60
2	L	L-Kalishta	Oligotrophic-A	33.43
3	L	L-Struga-Black Drin	Oligotrophic-Clear water	26.42
4	L	L-Sateska	Oligotrophic-A	38.21
5	L	L-Koselska	Oligotrophic-A	33.84
6	L	L- Ohrid bay	Oligotrophic-Clear water	28.91
7	L	L-Velidab	Oligotrophic-A	38.67
8	L	L-Bay of St. Naum	Oligotrophic-A	36.84
9	L	L-Tushemisht	Mesotrophic-Water moderately clear	43.08
10	L	L-Pogradec	Mesotrophic-Water moderately clear	46.78
11	L	L-Udenisht	Oligotrophic-A	30.70
12	L	L-Lin	Oligotrophic-Clear water	29.72
13	L	L-Lake Ohrid-Pelagic	Oligotrophic-Clear water	26.81

Finally, the Final Report of the Surveillance Monitoring Programme also concludes that "…results [of the monitoring] are in complete accordance with other studies, revealing the most water quality degraded waterbodies and that indeed an anthropogenic eutrophication is taking place in Lake Ohrid; …phosphorus concentration has increased four times over the past 100 years because of increased anthropogenic phosphorus loads. The building of a sewerage system and a treatment plant in North Macedonia in the 1980's has definitely had an effect on the P-load. In recent years this decrease seems to be compensated by increasing population. The alternation of decrease and increase in the P-concentration could explain why the increased input of the past decades cannot not be observed in the water quality. The domestic phosphorus input contributes the largest share to the anthropogenic P-load. Thus, it has the largest reduction potential at the moment. Furthermore, morphological alterations in the littoral zone of Lake Ohrid shape biological communities, and it is proposed that they are addressed. Finally, future intensification of agriculture could change the situation dramatically. As a result good agricultural practices should be communicated in following years".

5.4 PLAN FOR FUTURE MONITORING IN THE LOW IN LINE WITH FWD

Annex V indicates that monitoring information from surface waters is required for:

- ✓ the classification of status;
- ✓ supplementing and validating the Annex II risk assessment procedure;
- ✓ the efficient and effective design of future monitoring programmes;
- ✓ the assessment of long-term changes in natural conditions;
- ✓ the assessment of long-term changes resulting from widespread anthropogenic activity;
- ✓ estimating pollutant loads transferred across international boundaries or discharging into seas;
- ✓ assessing changes in status of those bodies identified as being at risk in response to the application of measures for improvement or prevention of deterioration;
- ✓ ascertaining causes of water bodies failing to achieve environmental objectives where the reason for failure has not been identified;
- ✓ ascertaining the magnitude and impacts of accidental pollution;
- ✓ assessing compliance with the standards and objectives of Protected Areas; and,
- ✓ quantifying reference conditions (where they exist) for surface water bodies should.

The results of surveillance monitoring shall be reviewed and used, in combination with the impact assessment procedure described in Annex II, to determine requirements for monitoring programmes in the current and subsequent river basin management plan.

As elaborated before, performed surveillance monitoring in the course of this project was not sufficient for obtaining the most reliable scientific data and applicable data base for determination of the ecological status of surface and ground waters in the LOW.

As stated in the WFD, the basic characteristics of operational monitoring systems are the following.

Operational monitoring has to be undertaken for all water bodies that have been identified, by the review of the environmental impact of human activities (Annex II) and/or from the results of the surveillance monitoring, as being at risk of failing the relevant environmental objectives under Article 4. Monitoring must also be carried out for all bodies into which priority substances are discharged. This implies that monitoring in all such bodies will not necessarily be required as the Directive allows similar water bodies to be grouped and representatively monitored. In addition, monitoring sites for those priority list substances with environmental quality standards should be selected according to the requirements of the legislation establishing the standards.

Based on obtained results, and aiming to resolve the basic causes of the recorded ecological situation in the basin, the following operational monitoring plan is proposed for the next immediate period within the timeframe of development of the management plan:

- ✓ a total of six (6) monitoring points on river water bodies should be selected; and
- ✓ a total of eight (8) monitoring points on lake water bodies should be selected.

Investigative monitoring may also be required in specified cases. These are given as:

- ✓ where the reason for any exceedences is unknown;
- ✓ where surveillance monitoring indicates that the objectives set under Article 4 for a body of water are not likely to be achieved and operational monitoring has not already been established, in order to ascertain the causes of a water body or water bodies failing to achieve the environmental objectives; or
- ✓ to ascertain the magnitude and impacts of accidental pollution.

The results of the monitoring would then be used to inform the establishment of a programme of measures for the achievement of the environmental objectives and specific measures necessary to remedy the effects of accidental pollution. Investigative monitoring will thus be designed to the specific case or problem being investigated.

Investigative monitoring for reference conditions of Ohrid Lake and river water bodies. Therefore, the proposal is to monitor four reference areas for rivers and to try to obtain the cleanest water courses and possibly to detect the natural background conditions. The proposal is to monitor physico-chemical and biological parameters at these 4 points at least 4 times per year, and two analyses of priority substances per year.

Based on the results of surveillance monitoring it is necessary Investigative monitoring for phosphorus in Ohrid Lake to be established. At least two waterbodies are classified as mesotrophic. This is in concordance with the scientific data that phosphorus concentrations are four times increased over the past 100 years due to the anthropogenic phosphorus loads.

6 ENVIRONMENTAL OBJECTIVES OF THE LOWMP

Having assessed the current status of the waters, the next stage is to set environmental objectives for the water resources in the LOW. Objective setting activities during development of the plan considered waters that require protection from deterioration as well as waters that require restoration and the timescales needed for recovery. This section of the plan sets out the objectives that the plan aims to achieve.

6.1 REGULATORY REQUIREMENTS

The WFD establishes demanding environmental objectives for surface waters and ground waters (Article 4). The Directive has four core environmental objectives; it also allows alternative objectives to be set in certain circumstances. The principal objective of the WFD is that Member States are required to achieve Good surface water status and Good groundwater status in 2015[44] at the latest. In. addition, the deterioration of waters whose status is already good or high, has to be prevented. In particular, the pollution of surface waters with priority substances and priority hazardous substances has to be reduced progressively and phased out in case of priority hazardous substances.

The WFD addresses different areas of legislation related to several separate Directives (Annex VI). The WFD also requires that a RBMP objectives and measures have to comply with requirements of these Directives.

6.2 LAKE OHRID WMP OBJECTIVES

The plan establishes four core environmental objectives to be achieved generally by 2031:

1. Restore good status of surface and ground water bodies;
2. Prevent deterioration of water bodies already having good or high status;
3. Reduce chemical pollution;
4. Achieve water related objectives for protected areas.

6.2.1 Restore Good Status of Surface and Ground Water Bodies

The objective set out in the WFD for surface waters and groundwater is to improve waters where necessary with the aim of achieving at least good ecological status. Restoring good status is to be achieved generally in a 15-year period where it is technically feasible, environmentally sustainable and not disproportionately expensive to do so. However, the WFD also recognizes that despite the implementation of measures some waters will take longer than others to reach their target because of the slower natural rates of recovery.

Based on the monitoring results and classification of 5 river water bodies and 1 AWB in the LOW are currently below good status and require restoration to good status/potential.

6.2.2 Prevent Deterioration

The WFD requires implementation of measures necessary to prevent deterioration in status of all surface waters and groundwater.

6.2.3 Reduce Chemical Pollution

The core objective is to progressively reduce surface water and groundwater pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances. Chemical monitoring programme, as part of the overall water quality monitoring system for the LOW, will be established.

6.2.4 Achieve Water Related Protected Areas Objectives

Some protected areas in the LOW currently do not meet protected areas objectives defined by EU Directives. The objective for the water bodies associated with these protected areas is to restore them so that they meet all applicable standards.

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[44] The dates stated in the WFD, adopted in 2000, are an obligation for the EU Member States.

6.3 TIME FRAME

As mentioned before, the WFD defines an initial 15-year period for accomplishment of objectives set out in watershed management plans. It further instructs (Article 11) that every 6 years thereafter the programme of measures defined with the plans should be reviewed and updated accordingly.

The time period assumed in this Plan for the LOW is the following:

- ✓ Phase I: 2020 – 2025; and
- ✓ Phase II: 2026 – 2031.

6.4 ALTERNATIVE OBJECTIVES

The WFD also allows alternative objectives/exemptions to be set in certain circumstances. In these cases, however, even where alternative objectives are set, measures must still be taken to achieve best possible status within the defined period. Alternative objectives may be necessary due to:

- ✓ technical, economic, environmental or cost recovery constraints. In some cases extended deadlines have been set for waters where necessary (time exemptions); and
- ✓ proposed new physical modifications and sustainable developments. Alternative, less stringent objectives may have to be set to cater for future projects (objective exemptions).

This plan establishes alternative objectives for certain water bodies related mainly to extended deadlines, i.e. deadlines beyond the analyzed 12-year period (2020 – 2031).

6.4.1 Extended Deadlines

Extended deadlines, usually of one additional planning cycle of 6 years, need to be applied to some water bodies due to technical, economic, environmental or cost recovery constraints. Also, in some cases further investigations are required to confirm the extent of impacts or to identify appropriate measures and implement them. The effectiveness of some measures is uncertain and status recovery is expected to take longer than the first planning cycle.

The reasons why timescale extensions may be needed to restore certain waters to good status in the LOW are set out in the matrix below.

Issue	Status level likely to fail	Water bodies likely to be affected	Constraint
NPK losses to surface waters (agriculture)	Phosphorus, nitrogen and potassium levels decreasing ecological status	4, 6, 9, 10, 12, 17, 18, 19, 20	Reductions/recovery from current high soil NPK levels to environmentally sustainable levels may take longer than the analyzed period (up to 12 years), even with full implementation of GAP measures. As a result, nutrient losses to waters may persist.
Dangerous substances/pollution from accumulated landfill leachate	Priority substances	Groundwater	Recovery of pollution accumulated in soil and groundwater from existing incompliant waste landfills will take longer than the analyzed period. Remediation of polluted soil to remove accumulated leachate pollution will increase waste service costs beyond affordability level.

6.5 EXPECTED RESULTS

It is estimated and expected that implementing planned measures (as defined further) will by 2031 achieve an Oligotrophic – Clear water trophic status in 11 of the 13 lake water bodies (i.e. the 6 LWB currently having Oligotrophic – A status will improve to Oligotrophic – Clear water) and the remaining 2 LWB currently having Mesotrophic status (LWB Tushemisht and LWB Pogradec) will, as a minimum, achieve an Oligotrophic – A status. In addition, the 2 river water bodies currently having Moderate status and the AWB Studenchishki kanal with Poor ecological status will achieve Good status, while the 2 RWB currently characterized as having Bad status (RWB Çeravë and RWB Sushica) will achieve, again as a minimum, Moderate status. Further improvements should be expected over the consequent planning cycles. Improvements of groundwater can be defined as data from monitoring activities are available.

7 PROGRAMME OF MEASURES

Section 6 sets out the environmental objectives for the LOWMP. This section describes the measures that need to be implemented to achieve those objectives.

It should be mentioned that significant progress has been made in recent years in putting the necessary legislation in place to support the implementation of river basin plans and programmes of measures in both countries sharing the basin. The core requirements of the WFD are transposed in the respective 'Water Laws'.

The key provisions of the Programme of Measures (PoM) for the LOW are summarized further. Proposed programme, following the WFD requirements is divided in basic and supplementary measures, followed by more precise distribution in selected groups of measures as indicated below. Further, following the provisions of the WFD Reporting Guidance (2016), proposed specific measures are linked to distinct water bodies, as well as with identified drivers, significant pressures and impacts; they are also associated with the predefined Key Types of Measures (KTM, as specified in the Guidance document), and reported along with KTM indicators and assessed expenditures for the two implementation periods. Finally, the PoM is fully aligned with the recently developed Strategic Action Programme for the entire Drin River Basin[45], as well as with other relevant plans and programs for water resource and protected areas management developed in both countries[46]. The full PoM is presented in Table 7.1 below.

7.1 POLICY, REGULATORY AND KNOWLEDGE BASE INCREASE MEASURES

Policy and regulatory measures are considered those measures that either come out as requirements of the legislation or this plan (e.g. establishment and implementation of water monitoring system, adopting new water pricing policies, harmonization of boating legislation, etc.), or aim at strengthening the institutional capacity for ensuring monitoring of LOW MP and its measures implementation, on a local level on IED implementation, including monitoring of performance of existing installations and their compliance with the permit conditions. Further, several measures are proposed which are focused on increasing the knowledge base regarding various aspects of the LOW, thus reducing uncertainties for future planning (e.g. conducting research for determination of reference conditions for Lake Ohrid, development of a type specific surface water classification system, groundwater status monitoring and classification, protected areas designation, climate change impact). Also, an analysis should be done on the necessity of designation of LOW as a nutrient sensitive area under the UWWT Directive and nitrate vulnerable area under the Nitrates Directive in order to mitigate the risk of eutrophication. The same can apply on the elaboration and implementation of specific legislation for using phosphates free detergents.

7.2 CONTROL OF URBAN WASTEWATER DISCHARGES

Inappropriate wastewater management. i.e. wastewater discharge, is certainly one of the most important sources of pollution in the LOW. Based on the analysis presented in Section 4.1 currently the ratio of households connected to public wastewater collection system for the basin equals 72%; the remaining 28% are assumed to use septic tanks for discharge of wastewater. Additional important aspect related to WWM in the LOW is the presence of a large number of tourists in the region, and in particular the distribution of visitors and overnights throughout the year, which creates significant imbalances of pollutant load to water bodies. Further, although there are two central WWM systems (WWTP Vranishta in North Macedonia and Tushemisht in Albania) and several small-scale (decentralized) plants for local tourist facilities around the lake, these are currently facing a number of problems and limitations in their daily operation. Finally, apart from previous studies, the surveillance monitoring programme that was carried out in 2019 also confirmed that anthropogenic eutrophication is taking place in Lake Ohrid, with the domestic phosphorus input contributing the largest share in the total anthropogenic phosphorus load.

Thus, it is expected that during the analyzed 12-year period the WFD requirements regarding WWM should be given highest priority and fully met. Proposed measures for control of urban wastewater discharges (Table 7.1) take into consideration reconstruction and upgrade of the two central WWM systems, completion of sewer networks in settlements and connecting these networks to the central systems, construction of small-scale WWM systems

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[45] "Drin Basin: The Strategic Action Programme", Draft Version; GWP-Med (12 September 2019).

[46] E.g. "World Heritage Supplement to the Management Plan for Pogradec Protected Landscape. Draft August 2017"; Programme 1: Protecting and managing Lake Ohrid (pollution control and reduction, fishery management).

in villages that will be equipped with WWTPs, and termination of combined sewer systems (i.e. construction of separate surface runoff systems) in urban areas around the lake. Conducted analysis for determination of the size/capacity and required expenditures for the WWM systems are based on input data from the JICA-study mentioned in Section 4.1[47].

7.3 WASTE MANAGEMENT

The sub-group of measures is focused on activities for mitigation of another major pollution sector – solid waste management. It includes improvements in waste collection activities and establishment of regional waste management centers, which in general is an accepted strategy for waste management in both countries, but as well on measures for closure and remediation of the existing non-compliant municipal landfills and village dump sites, introduction of waste recycling, etc. The analyses for both countries are based on unit input data from a study for establishment of regional waste management plan for the South-east region in North Macedonia[48]. In Albania, solid waste of Pogradec Municipality is transferred to Maliq Landfill and a transfer station exists within Pogradec Municipality.

7.4 CONTROL OF AGRICULTURAL SOURCES OF POLLUTION

Proposed measures within this group refer to control of diffuse (non-point) pollution which is result of agriculture activities. Identified measures are divided in the following sub-groups:

- ✓ Control of fertilizer and pesticide use measures, referring mainly to implementation of good agricultural practices (GAP) in crop cultivation and farm management, with the aim of reducing nutrient (fertilizer) and pesticide pollution; and
- ✓ Agriculture waste and hazardous materials management measures, focused on managing of agriculture waste and waste materials: pesticide and fertilizer packaging (hazardous) waste; PE waste; organic (bio-degradable) waste; and mainly liquid waste from cleaning of agriculture machinery.

7.5 CONTROL OF WATER WITHDRAWALS

This group refers to activities for control of water abstraction (withdrawal) from the basin and increase of water use efficiency. The following sub groups of measures are taken into consideration:

- ✓ control of irrigation water withdrawals, Irrigation is the largest water consumer in the basin. On the other hand current irrigation practices are extremely inefficient. Therefore, a specific focus is given to development and implementation of measures directed at increasing the economy of water use for agriculture purposes. Foreseen measures include:
  - upgrading of existing irrigation schemes, to enable use of modern irrigation techniques (e.g. drip irrigation);
  - promotion and application of advanced irrigation and fertigation technologies on individual farms;
  - promotion of cropping pattern/mix change; and irrigation demand automation measures; and
- ✓ control of municipal and industrial water withdrawals, by reducing physical water losses in drinking and industry water supply networks, mainly in urban areas. Foreseen activities include supply side measures (reparation of water leaks and network upgrade), as well as demand side measures (increased water metering, development and promotion of new water supply codes, etc.).

7.6 FISHERY AND BIODIVERSITY MANAGEMENT MEASURES

As pointed out in Section 4.4, even though fishery master plans are in place in both countries and major efforts for restocking are continuously being implemented for several decades, as a result of inadequate protection and unsustainable fishing practices the two endemic Salmonid species of the lake (Ohrid Trout and Belvica) are at threat of possible irreversible loss of their populations. Further, additional pressure is the presence of introduced (alien) fish species in the lake.

Therefore, particular measures are proposed which by and large refer to harmonization of the fishery regulations in both countries and adoption of a joint Fishery Master Plan, as a main prerequisite for further continuous

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47 "Data Collection Survey for Ohrid Lake Environmental Improvement", Final Report. Japan International Cooperation Agency (JICA), MoEPP (October 2012).

48 "Preparation of Documents for Establishment of Integrated and Financially Sustainable Systems for Waste Management Centers – Southeast region"; EuropeAid/136347/IH/SER/MK. ENVIROPLAN S.A. and consortium partners: Louis Berger, BiPRO GmbH, EPEM S.A., SLR Consulting Limited (2016).

implementation of activities for controlling of listed adverse impacts. In addition, measures such as upgrading the capacity of the restocking hatcheries, as well as for strengthening of fishing inspection units are also planned.

7.7 OTHER MEASURES

The group of other projected measures includes:

- ✓ protected areas measures, focused mainly on restoration and improved management of protected areas (e.g. drinking water supply sources) within the LOW;
- ✓ remediation of contaminated industrial sites. As mentioned in Section 4.2, in addition to eutrophication Lake Ohrid is also under pressure of pollution resulting from abandoned old chromium, iron and nickel mines outside Pogradec in Albania. Therefore, the plan includes implementation of measures and activities focused on mitigation of this pressure in the form of:
  - detailed site investigations for precise determination of the contamination extent and selection of preferred clean-up technologies, and
  - implementation of remediation works;
- ✓ flow diversion – hydropower, the measure refers to reducing the highly negative impact from Sateska river on Lake Ohrid (see Section 4.7), through implementation of design and civil works for re-routing the main flow of the river in its original riverbed with discharge directly into the Black Drin river and additional erosion-control activities. The concept that is observed here is based on analysis carried out in 1998 by the Directorate for Water Economy in North Macedonia49 and includes four phases:
  - reconstruction of the section of Sateska river from the Volino village to Black Drin (8 km length) to enable a flow-capacity of 100 m3/sec and construction of a special flow-diversion structure with the same capacity,
  - regulation of the upper section of the Sateska riverbed (channel) from Volino to Klimeshtica (20 km length),
  - construction of check dams (sediment settling basins) along the upper section of Sateska, and
  - implementation of reforestation and other erosion-control measures on the upper section. These works will enable full control of up to Q50-year flow in Sateska of 180 m^3/sec, whereas in the case of such an event Q100 m^3/sec will surge directly to Black Drim and the remaining 80 m^3/sec to Lake Ohrid. Thus, the solution will prevent practically all current discharge of sediment and nutrients (phosphorus and nitrogen) in the lake, without affecting the annual hydropower generation on the cascade reservoirs/HPPs along the Drin river; and
- ✓ other anthropogenic pressure management measures, focused on activities for mitigation of the remaining major anthropogenic pressure – boating. Besides harmonization of boating legislation with the EU standards and strengthening the capacity of boating administrations, this sub group also includes construction of modern docking (boat) marinas on both sides of the lake.

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[49] Zavod za Vodostopanstvo, 1998.

Table 7.1: Programme of Measures

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators 2020-2025	KTM Indicators 2026-2031	Expenditure (EUR) 2020-2025	Expenditure (EUR) 2026-2031
1.1 - Point – Urban waste water	Urban development Tourism and recreation	CHEM/ MICR/ NUTR/ ORGA	**2, 3, 5, 6, 7, 17, 18**	9, 10 (MKD)	B	• Setting up of advanced WWM tariff policy for households, commercial needs (tourism) and SMEs in Municipalities of Struga and Ohrid based on the national ERC methodology	[*See indicators specified under pressure 3.2 below*]			
		CHEM/ MICR/ NUTR/ ORGA	**2, 3, 5, 6, 7, 17, 18**	1 (MKD)	B	• Preparation/update of Feasibility Study and engineering design documents • Reconstruction and upgrading of the existing WWM system Vranishta	PE required to be treated by upgrade of WWM: 80,000 curr. + 40,000 (120,000 max)		€23,240,000	
		CHEM/ MICR/ NUTR/ ORGA	**9, 10, 11, 12, 19**	9, 10 (AL)	B	• Setting up of advanced water WWM tariff policy for households, commercial needs (tourism) and SMEs in Municipality of Pogradec	[*See indicators specified under pressure 3.2 below*]			
		CHEM/ MICR/ NUTR/ ORGA	**9, 10**	1	B	• Preparation of Feasibility Study and engineering design documents • Reconstruction and upgrading of the existing WWM system Tushemisht	PE required to be treated by upgrade of WWM: 40,000 (max)		€14,300,000	
		MICR/ NUTR/ ORGA	**1**	1 (MKD)	B	• Extension of the existing WWM system Vranishta, to connect all settlements and tourist facilities in the WB (L-Radozhda) • Construction of secondary sewers in Radozhda village and tourist facilities in WB	Number of WWT works to be constructed/upgraded: 1 PE to be treated by extension/upgrade of WWM: 1,700		€1,090,000	
		MICR/ NUTR/ ORGA	**2**	1 (MKD)	B	• Completion of secondary sewer systems in Kalishta, Frangovo and Mali Vlaj villages and tourist facilities in WB	Number of WWT works to be constructed/upgraded: 3		€6,080,000	

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
						• Connecting secondary sewer systems to the central WWM system Vranishta	PE to be treated by extension/upgrade of WWM: 3,000			
		MICR/ NUTR/ ORGA	**5, 17, 18, 20**	1 (MKD)	B	• Completion of secondary sewer systems in settlements and tourist facilities in WBs • Connecting secondary sewer systems to the central WWM system Vranishta, or construction of distributed small-scale WWM systems for individual settlements	PE required to be treated by upgrade/extension of WWM: 3,700		€2,380,000	
		MICR/ NUTR/ ORGA	**6**	1 (MKD)	B	• Completion of secondary sewer systems in Ohrid, Istok and Racha settlements and tourist facilities in WB • Connecting secondary sewers to the central WWM system Vranishta	Number of WWT works to be constructed/upgraded: 3 PE required to be treated by upgrade/extension of WWM: 4,000		€2,570,000	
		MICR/ NUTR/ ORGA	**7**	1 (MKD)	B	• Completion of secondary sewer systems in settlements (Eleshec, Elshani, Sv. Stefan) and tourist facilities in WB (sewer systems connected to WWM Vranishta)	Number of WWT works to be constructed/upgraded: 2 PE required to be treated by upgrade/extension of WWM: 4,200		€2,700,000	
		MICR/ NUTR/ ORGA	**7**	1 (MKD)	B		PE required to be treated by upgrade of WWM		€4,420,000	

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
						• Construction of small-scale WWTM systems for Trpejca, Ljubanishta, Velestovo villages and tourist facilities	4,300			
							Number of WWT works to be constructed			
							3			
		MICR/ NUTR/ ORGA	**8**	1 (MKD)	B	• Reconstruction/upgrading of small-scale WWM system in St. Naum	Number of WWT works to be constructed/upgraded		€250,000	
							1			
		MICR/ NUTR/ ORGA	**9, 19**	1 (AL)	B	• Construction/completion of secondary sewer systems in settlements and tourist facilities in WB (Çerravë and Dardhas Admin Units) • Connecting secondary sewer systems to the central WWM system Tushemisht, or construction of distributed small-scale WWM systems for settlements	PE required to be treated by upgrade of WWM		€6,420,000	
							10,000			
		MICR/ NUTR/ ORGA	**10**	1 (AL)	B	• Completion of secondary sewer systems in settlements and tourist facilities in WB Pogradec (Buçimas and Pogradec Admin Units) • Connecting secondary sewer systems to the central WWM system Tushemisht	PE required to be treated by upgrade of WWM		€4,600,000	
							7,100			
		MICR/ NUTR/ ORGA	**11**	1 (AL)	B	• Construction of small-scale WWTM systems for settlements and tourist facilities in WB Hudenisht (Hudenisht Admin Unit)	PE required to be treated by upgrade of WWM		€3,000,000	
							3,000			
		MICR/ NUTR/ ORGA	**12**	1 (AL)	B	• Construction of small-scale WWTM systems for settlements and tourist facilities in WB Lin (Hudenisht Admin Unit)	PE required to be treated by upgrade of WWM		€3,500,000	
							3,500			

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
1.2 - Point – Storm overflows	Urban development Tourism and recreation	CHEM/ OTHE	**3**	1, 21 (MKD)	B	• Termination of combined sewer, by construction (or completion) of separate storm/surface runoff collection system in Struga and disconnecting existing storm runoff connections from the WWM system Vranishta	Number of sustainable drainage systems			€5,000,000
							1 (0%)	(100%)		
		CHEM/ OTHE	**6**	1, 21 (MKD)	B	• Termination of combined sewer, by construction (or completion) of separate storm/surface runoff collection system in Ohrid and disconnecting existing storm runoff connections from the WWM system Vranishta	Number of sustainable drainage systems			€4,000,000
							1 (0%)	(100%)		
		CHEM/ OTHE	**10**	1, 21 (AL)	B	• Termination of combined sewer, by construction (or completion) of separate storm/surface runoff collection system in Pogradec and disconnecting existing storm runoff connections from the WWM system Tushemisht	Number of sustainable drainage systems			€2,000,000
							1 (0%)	(100%)		
		CHEM/ OTHE	**2, 5, 6, 7, 17, 18**	1, 21 (MKD)	B	• Disconnection of existing housing and tourist facilities' storm runoff connections from the WWM system Vranishta (all WB settlements in Struga and Ohrid municipalities with sewers connected to WWM Vranishta)	Number of upgraded storm overflows			€9,000,000
								TBC		
		CHEM/ OTHE	**9, 10**	1, 21 (AL)	B	• Disconnection of existing housing and tourist facilities' storm runoff connections from the WWM system Tushemisht (all WB settlements in Buçimas, Çerravë, Dardhas and Pogradec Admin Units with sewers connected to WWM Tushemisht)	Number of upgraded storm overflows			€2,000,000
								TBC (100%)		
1.3 - Point –- IED plants	Industry	CHEM/ ECOS/ ORGA/ OTHE	**1, 2, 3, 5, 6, 7, 8, 17, 18, 20**	10, 16 (MKD)	S	• Development and implementation of capacity building program for local government employees in Municipalities of Struga and Ohrid on environmental permitting procedure and enforcement of	Number of trained municipal employees		€250,000	
							4			

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
						IED/SEVESO/IPPC legislation for industry (IPPC Type B)				
					B	• Revisiting and continuous monitoring of compliance with environmental requirements for existing IED/IPPC Type B permits (industrial units)	Number of revised permits		€750,000	
							14			
		CHEM/ ECOS/ ORGA/ OTHE	**9, 10, 11, 12**	10, 16 (AL)	S	• Development and implementation of capacity building program for local government employees in Municipality of Pogradec on environmental permitting procedure and enforcement of IED/SEVESO/IPPC legislation for industry (IPPC Type B and C)	Number of trained municipal employees		€200,000	
							3			
					B	• Revisiting and continuous monitoring of compliance with environmental requirements for existing IED/IPPC Type B/C permits (industrial units)	Number of revised permits		€600,000	
							11			
1.6 - Point – Waste disposal	Urban development	CHEM/ ECOS/ LITT/ MICR/ NUTR	**1, 2, 3, 5, 6, 7, 8, 17, 18, 20**	21 (MKD)	B	• Site identification and selection; preparation of design documents for development of regional waste management facility for Ohrid and Struga Municipalities (Southwest Region in MKD) • Construction of regional waste management facility for Ohrid and Struga Municipalities (Southwest Region in MKD)	Population from LOW to be covered by the regional WM facility		€8,880,000	€5,920,000
							85,000			
							Waste disposal capacity (t/y) at regional WM facility for LOW			
							32,000 t/y			
			9, 10, 11, 12	21 (AL)	B	• Site identification and selection; preparation of Feasibility Study and engineering design documents for development of regional waste management facility (landfill) for Pogradec Municipality (Buçimas,	Population from LOW to be covered by the regional WM facility		€5,400,000	€3,600,000
							55,000			
							Waste disposal capacity (t/y) at			

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
						Çerravë, Dardhas, Pogradec and Hudenisht Admin Units)	regional WM facility for LOW			
						• Construction of regional waste management facility for Pogradec Municipality	20,000 t/y			
			1, 2, 3, 5, 6, 7, 8, 17, 18, 20	21 (MKD)	B	• Closure of existing municipal landfills in Municipalities of Ohrid (Bukovo) and Struga, including remediation of the landfill sites	No. of remediated waste disposal sites		€4,200,000	€260,000
							4			
			9, 10, 11, 12	21 (AL)	B	• Closure of existing municipal landfill in Municipality of Pogradec (Çerravë Admin Unit) and remediation of the landfill site	Number of remediated waste disposal sites		€2,700,00	€175,000
							1			
			1, 2, 3, 5, 6, 7, 8, 17, 18, 20	21 (MKD)	B	• Closure of illegal (village) dumps in Municipalities of Ohrid and Struga, including remediation of the landfill sites	Number of remediated illegal dumps		€175,000	
							19			
			9, 10, 11, 12	21 (AL)	B	• Closure of illegal dumps (villages within the LOW) in Municipality of Pogradec, including remediation of the landfill sites	Number of remediated illegal dumps		€100,000	
							TBD			
1.8 - Point - Aquaculture	Fisheries and aquaculture	CHEM/ ORGA	**13**	18 (AL)	S	• Closure of the fish farms with rainbow trout, or upgrading to farming of Ohrid trout (required intervention on the outlet water)	Number of closed aquaculture facilities		€50,000	
							TBD			
				1 (MKD)	S	• Construction of small-scale WWM systems for on outlet water at HBI Ohrid	Number of WWT works to be constructed		€100,000	
							1			
2.1 - Diffuse - Urban runoff	Urban development Tourism and recreation	CHEM/ OTHE	**1 to 20**	21	B	[*See measures, indicators and investments specified under pressure 1.2 above*]				
2.2 - Diffuse – Agricultural	Agriculture	CHEM/ ECOS/ NUTR	**2, 3, 4, 5, 6, 7, 17, 18**	2, 12 (MKD)	S	• Reduce nutrient pollution from agriculture through optimization of	Area of agricultural land required to be covered		€850,000	€550,000

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
						mineral fertilizers use efficiency by laboratory soil testing, fertilization plans on areas with intensive agricultural systems	4,000 ha (60% of tot)	2,680 ha (40% of tot)		
			9, 10, 11 12, 19	2, 12 (AL)	S	• Reduce nutrient pollution from agriculture through optimization of mineral fertilizers use efficiency by laboratory soil testing, fertilization plans on areas with intensive agricultural systems	Area of agricultural land required to be covered		€400,000	€250,000
							1,970 ha (60% of tot)	1,300 ha (40% of tot)		
			2, 3, 4, 5, 6, 7, 17, 18	2, 12 (MKD)	S	• Advisory services for agriculture: Development of facilities and procedures for proper on farm management and storage of organic (manure) fertilizer	Number of farms that need to be covered by advisory services		€1,500,000	€2,000,000
							40%	30%		
			9, 10, 11 12, 19	2, 12 (AL)	S	• Advisory services for agriculture: Development of facilities and procedures for proper on farm management and storage of organic (manure) fertilizer	Number of farms that need to be covered by advisory services		€700,000	€500,000
							40%	30%		
			2, 3, 4, 5, 6, 7, 17, 18	2, 12 (MKD)	S	• Advisory services for agriculture: Implementing procedures and enforcing capacities for application of manure in line with Nitrate directive provisions	Number of farms that need to be covered by advisory services		€1,800,000	€1,100,000
							30%	20%		
			9, 10, 11 12, 19	2, 12 (AL)	S	• Advisory services for agriculture: Implementing procedures and enforcing capacities for application of manure in line with Nitrate directive provisions	Number of farms that need to be covered by advisory services		€600,000	€350,000
							30%	20%		
			2, 3, 4, 5, 6, 7, 17, 18	2, 12 (MKD)	B	• Reduce nutrient pollution from agriculture: Delineation of vulnerable areas in a line with Nitrate directive	Area of buffer zones required to be covered		€1,200,000	€550,000
							70%	30%		
			9, 10, 11 12, 19	2, 12 (AL)	B	• Reduce nutrient pollution from agriculture: Delineation of vulnerable areas in a line with Nitrate directive	Area of buffer zones required to be covered		€300,000	€100,000
							70%	30%		
			2, 3, 4, 5, 6, 7, 17, 18	2, 12 (MKD)	S	• Reduce nutrient pollution from agriculture: Introduction of on farm agro-	Area of agricultural land required to be covered		€1,900,000	€1,400,000

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
						ecological measures for sustainable agricultural production	2,670 ha	2,000 ha		
			9, 10, 11 12, 19	2, 12 (AL)	S	• Reduce nutrient pollution from agriculture: Introduction of on farm agro-ecological measures for sustainable agricultural production	Area of agricultural land required to be covered		€900,000	€700,000
							1,300 ha	980 ha		
			2, 3, 4, 5, 6, 7, 17, 18	3, 12 (MKD)	S	• Reduce pesticides pollution from agriculture: Implementation of plant protection programs for optimization of pesticide use and effective pest control	Area of agricultural land required to be covered		€900,000	€600,000
							3,000 ha	2,350 ha		
							Number of farms that need to be covered by advisory services			
							45%	35%		
			9, 10, 11 12, 19	3, 12 (AL)	S	• Reduce pesticides pollution from agriculture: Implementation of plant protection programs for optimization of pesticide use and effective pest control	Area of agricultural land required to be covered		€300,000	€200,000
							1,300 ha	980 ha		
							Number of farms that need to be covered by advisory services			
							45%	35%		
			2, 3, 4, 5, 6, 7, 17, 18	3, 12 (MKD)	S	• Reduce pesticides pollution from agriculture: Development of facilities and procedures for proper on farm management of pesticides and storage	Number of farms that need to be covered by advisory services		€900,000	€600,000
							(45%)	(35%)		
			9, 10, 11 12, 19	3, 12 (AL)	S	• Reduce pesticides pollution from agriculture: Development of facilities and procedures for proper on farm management of pesticides and storage	Number of farms that need to be covered by advisory services		€300,000	€200,000
							(45%)	(35%)		
			2, 3, 4, 5, 6, 7, 17, 18	15 (MKD)	S	• Development of facilities for collection and processing of agricultural organic by-products	Number of farms that need to be covered by advisory services		€1,000,000	€800,000
							(30%)	(40%)		

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
			9, 10, 11 12, 19	15 (AL)	S	• Development of facilities for collection and processing of agricultural organic by-products	Number of farms that need to be covered by advisory services		€400,000	€250,000
							(30%)	(40%)		
2.5 - Diffuse – Contaminated or abandoned industrial sites	Industry	CHEM/ OTHE	**9, 10, 11, 12**	4 (AL)	B	• Remedial Investigation /Feasibility Study, for determination of nature and extent of contamination. Assess the treatability of site contamination and evaluates the potential performance and cost of treatment technologies • Implementation of remediation (clean-up) activities	Area of land covered by the measures (ha) required to achieve objectives			
							5	15	€1,500,000	€4,500,000
2.6 - Diffuse – Discharges not connected to sewer network	Urban development Tourism and recreation	MICR/ NUTR/ ORGA	**1 to 20**	21	B	[*See measures, indicators and investments specified under pressure 1.1 above*]				
2.9 - Diffuse – Aquaculture	Fisheries and Aquaculture		**13**	18, 1	S	[*See measures, indicators and investments specified under pressure 1.8 above*]				
3.1 - Abstraction or flow diversion – Agriculture	Agriculture	LOWT	**2, 3, 4, 5, 6, 7, 17, 18**	8 (MKD)	S	• Restoration of existing irrigation channel scheme	Area of irrigated land required to be covered		€2,000,000	€1,500,000
							400 ha	300 ha		
			9, 10, 11 12, 19	8 (AL)	S	• Restoration of existing irrigation channel scheme	Area of irrigated land required to be covered		€1,500,000	€1,000,000
							300 ha	200 ha		
			2, 3, 4, 5, 6, 7, 17, 18	8 (MKD)	S	• Introduction/application of modern irrigation systems (drip and sprinkle irrigation)	Area of irrigated land required to be covered		€1,600,000	€800,000
							800 ha	400 ha		
			9, 10, 11 12, 19	8 (AL)	S	• Introduction/application of modern irrigation systems (drip and sprinkle irrigation)			€800,000	€500,000
							400 ha	250 ha		
			2, 3, 4, 5, 6, 7, 17, 18	8 (MKD)	S	• Introduction of advanced approaches in soil moisture controlling systems and irrigation scheduling	Area of irrigated land required to be covered		€1,200,000	€600,000
							800 ha	400 ha		

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
			9, 10, 11 12, 19	8 (AL)	S	• Introduction of advanced approaches in soil moisture controlling systems and irrigation scheduling	Area of irrigated land required to be covered		€600,000	€375,000
							400 ha	250 ha		
			2, 3, 4, 5, 6, 7, 17, 18	8 (MKD)	S	• Introduction of fertigation in high productive agricultural systems	Area of irrigated land required to be covered		€1,200,000	€600,000
							800 ha	400 ha		
			9, 10, 11 12, 19	8 (AL)	S	• Introduction of fertigation in high productive agricultural systems	Area of irrigated land required to be covered		€600,000	€375,000
							400 ha	400 ha		
			2, 3, 4, 5, 6, 7, 17, 18	24 (MKD)	S	• Mitigation of negative impact of climate change with implementing of adaptive measures for more effective water savings	Number of farms that need to be covered by advisory services		€2,700,000	€2,000,000
							55%	25%		
			9, 10, 11 12, 19	24 (AL)	S	• Mitigation of negative impact of climate change with implementing of adaptive measures for more effective water savings	Number of farms that need to be covered by advisory services		€1,200,000	€950,000
							45%	30%		
			2, 3, 4, 5, 6, 7, 17, 18	11 (MKD)	B	• Improve water pricing policy and implementation of cost recovery measures for water services from agriculture	Agricultural area (ha) where water pricing policy measures are required		€100,000	
							2,000 ha			
			9, 10, 11 12, 19	11 (AL)	B	• Improve water pricing policy and implementation of cost recovery measures for water services from agriculture	Agricultural area (ha) where water pricing policy measures are required		€100,000	
							5,000 ha			
3.2 – Abstraction/ flow diversion – Water supply	Urban development Tourism and recreation	LOWT	**1, 2, 3, 6, 7, 8, 17, 18, 20**	9 (MKD)	B	• Reevaluating existing water supply tariff policy of CPE covering Municipalities of Struga and Ohrid, following cost recovery and PP principles; Setting up of advanced water supply tariff policy for households, commercial needs (tourism) and SMEs based on the national ERC methodology	Population for which water pricing policy measures are required		€100,000	
							76,000			

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
			1, 2, 3, 6, 7, 8, 17, 18, 20	8 (MKD)	S	• Development and implementation of a water supply efficiency increase program, to reduce non-revenue water in Municipalities of Struga and Ohrid (all settlements and tourism sites) to a sustainable level	Reduction (%) in non-revenue water required		€4,200,000	€4,200,000
							35%	35%		
			1, 2, 3, 6, 7, 8, 17, 18, 20	13 (MKD)	B	• Reassessment of compliance with EU directives and standards, or establishment of appropriate safeguard (buffer) zones for drinking water abstraction sources (wells, springs) in Municipalities of Struga and Ohrid	Number of drinking water protection zones required		€1,000,000	
							TBD			
		LOWT	**9, 10, 11, 12, 19**	9 (AL)	B	• Reevaluating existing water supply tariff policy of CPE covering Municipality of Pogradec, following cost recovery and PP principles; Setting up of advanced water supply tariff policy for households, commercial needs (tourism) and SMEs	Population for which water pricing policy measures are required		€100,000	
							30,000			
			9, 10, 11, 12, 19	8 (AL)	S	• Development and implementation of a water supply efficiency increase program, to reduce non-revenue water in Municipality of Pogradec (all settlements and tourism sites) to a sustainable level	Reduction (%) in non-revenue water required		€1,900,000	€1,900,000
							35%	35%		
			9, 10, 11, 12, 19	13 (AL)	B	• Reassessment of compliance with EU directives and standards, or establishment of appropriate safeguard (buffer) zones for drinking water abstraction sources (wells, springs) in Municipality of Pogradec	Number of drinking water protection zones required		€500,000	
							TBD			
3.3 - Abstraction or flow diversion – Industry	Industry			S		[*See measures, indicators and investments specified under pressure 3.2 above*]				
3.5 – Flow diversion –	Energy – hydropower	HHYC/ HMOC/	**13, 14, 15, 16**	5, 6, 7, 17	B	• Preparation of Feasibility Study and engineering design documents	Length of rivers (km) affected by the measure		€14,220,000	

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
Hydropower (Sateska river)		NUTR/ ORGA		(MKD)		• Implementation of construction activities and measures for rediverting of Sateska river in its original flow (riverbed) with discharge into Black Drin river	8 km			
							Number of water bodies affected by the measures			
							4			
3.6 - Abstraction or flow diversion - Fish farms	Fisheries and Aquaculture	NOSI	**13**	S		[*See measures, indicators and investments specified under pressure 1.8 above*]				
4.1.1 - Physical alteration of channel – Flood protection	Energy – hydropower Flood protection	NOSI		S		[*Minor pressure, no measures*]				
5.1 - Introduced species and diseases	Fisheries and aquaculture	OTHE	**13**	18	B	• Implementation of measures to control adverse impacts of invasive alien species: ♦ Permanent fish stock and fisheries monitoring ♦ Establishment of Eel Management Units according to EU eel Regulation ♦ Introduction of measures for eradication of invasive fish species (L. gib.)	Number of species for which codes of practice to reduce spread of invasive alien species are required		€1,250,000	
							6			
5.2 - Exploitation or removal of animals	Fisheries and aquaculture	OTHE	**13**	20	S	• Harmonization (coordination) of fishery regulations between AL and MKD, including (1) detailed fish stock assessment and (2) preparation of joint Fishery Management Plan. • Implementation of measures to control adverse impacts of fishing and other removal of animals:	Number of water bodies affected by the measures		€4,000,000	
							1			
							Area of water bodies (km2) affected by the measure			
							356 km2			

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
						♦ Permanent fish stock and fisheries monitoring (also in 5.1) ♦ Introduction of new fishing techniques for bleak exploitation from the lake ♦ Establishment of a common minimal catchable size (fishing gears) and fishing quotas for both countries ♦ Reassessment of efficiency of fish-management practices (concession) ♦ Upgrading of volume (capacity) and standards of trout hatcheries Ohrid and Shum (MKD), Lin (AL) ♦ Strengthening of fishing inspection (Law Enforcement) units in MKD, AL				
5.3 – Litter or fly tipping	Urban development	CHEM/ LITT/ MICR/ NUTR	**1, 2, 3, 5, 6, 7, 8, 17, 18, 20**	21 (MKD)	S	• Improved/upgraded waste collection in urban areas (settlements) and tourist facilities • Introduction of waste recycling practices	[*Indicators and investments specified under pressure 1.6*]			
			9, 10, 11, 12	21 (AL)	S	• Improved/upgraded waste collection in urban areas (settlements) and tourist facilities • Introduction of waste recycling practices	[*Indicators and investments specified under pressure 1.6*]			
7 – Anthropogenic pressure – Other (boating, tourism, recreation)	Tourism and recreation Fisheries and aquaculture Transport/ Navigation	CHEM/ OTHE	**13**	19, 21 (MKD, AL)	S	• Harmonization of boating legislation and regulations (bylaws) with the pertinent EU Directives and standards	Area of water bodies (km2) affected by the measure 356 km2		€100,000	
				19, 21 (MKD	S	• Strengthening the capacity of the Port Authority in Ohrid	Area of water bodies (km2) affected by the measure 356 km2		€200,000	

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
				19, 21 (AL)	S	• Analysis of requirements and possibilities for establishment of independent port authority in Pogradec	Area of water bodies (km2) affected by the measure 356 km2		€100,000	
				19, 21 (MKD)	S	• Site identification and selection; preparation of Feasibility Study and engineering design documents for development of joint boat marina for Ohrid and Struga municipalities. Estimated capacity 1,000 boats. • Construction of a modern boat marina for Ohrid and Struga.	Area of water bodies (km2) affected by the measure 356 km2		€15,000,000	
				19, 21 (AL)	S	• Site identification and selection; preparation of Feasibility Study and engineering design documents for development of boat marina in Pogradec. Estimated capacity 250 boats. • Construction of a modern boat marina in Pogradec.	Area of water bodies (km2) affected by the measure 356 km2		€3,750,000	
			8	21 (MKD)	S	• Development and implementation of plan for protection and management of the wider area around the surface springs at St. Naum	Area of water bodies (km2) affected by the measure		€1,000,000	
			9	21 (AL)	S	• Development and implementation of plan for protection and management of the wider area around the surface springs at Tushemisht	Area of water bodies (km2) affected by the measure		€1,000,000	
Policy measures, research, knowledge base	N/A	N/A	**1 - 20**	14	S	• Preparation and development of monitoring programme for transboundary water resource management in the LOW, in accordance with WFD: ♦ Preparation of a study to assess: (1) existing monitoring programmes and	Assessment study identifying need for monitoring Agreement on transboundary monitoring stations		€250,000	

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
						capacities on national level and (2) required needs and procedures to perform monitoring in the LOW at the transboundary level, in accordance with EU Directives ♦ Agreement on LOW transboundary monitoring programme: (1) agreement on transboundary monitoring program locations; (2) agreement on transboundary monitoring program requirements and procedures; (3) preparation of joint monitoring guidelines based on international guidance and standards for implementing monitoring protocols ♦ Designation of appropriate authorities responsible for the implementation of the transboundary monitoring programme	Agreed list of monitoring parameters and protocols			
					S	• Updating and increasing precision of water balance for the entire Prespa-Ohrid Lakes Watershed, including analysis of potential climate chenge impact on both lakes	Assessment study reporting (detailing) water balance (hydrology) aspects of the Prespa-Ohrid basin		€500,000	
					S	• Conducting research and establishment of reference conditions for future determination of ecological status of Lake Ohrid water bodies	Study establishing reference conditions for assessment of biological quality status of Lake Ohrid water bodies		€250,000	
					S	• Conducting analysis for improved water resource management (outflow from Lake Ohrid), to balance the needs of all stakeholders	Study with recom-mendations for improved management of outflow regimes from Lake Ohrid		€100,000	

Pressure	Driver	Impact Type[1]	WB[2]	KTM[3]	B/S[4]	Specific Measure	KTM Indicators		Expenditure (EUR)	
							2020-2025	2026-2031	2020-2025	2026-2031
					S	• Preparation and development of programme for reed management	Study with recommendations for long-term reed management in the LOW		€100,000	

1: Impact types

CHEM - Chemical pollution	HMOC - Altered habitats due to morphological changes	NOSI - No significant impact
ECOS - Damage to groundwater-dependent terrestrial ecosystems	LOWT - Abstraction exceeds available groundwater resource	NUTR - Nutrient pollution
HHYC - Altered habitats due to hydrological changes	MICR - Microbiological pollution	ORGA - Organic pollution

2: Water Bodies

[1]	L-Radozhda	[6]	L- Studenchishki kanal	[11]	L-Udenisht	[16]	R-Sateska 3
[2]	L-Kalishta	[7]	L-Velidab	[12]	L-Lin	[17]	R-Koselska 1
[3]	L-Struga-Black Drin	[8]	L-Bay of St. Naum	[13]	L-Lake Ohrid-Pelagic	[18]	R-Koselska 2
[4[	L-Sateska	[9]	L-Tushemisht	[14]	R-Sateska 1	[19]	R-Cerave
[5]	L-Koselska	[10]	L-Pogradec	[15]	R-Sateska 2	[20]	Sushica

3: Key Type Measures: Appendix D.

4: Basic or Supplementary Measure.

8 ECONOMIC ANALYSIS

8.1 PURPOSE OF THE ECONOMIC ANALYSIS

The WFD puts a strong emphasis on conducting economic analysis in the preparation of basin management plans. The purpose of the economic analysis is to provide valuable information to aid policy decision making with the aim of achieving defined environmental and resource protection goals.

The specific objectives of the analysis include:

- ✓ understanding the economic issues and tradeoffs at stake in a river/lake basin, as a starting point in assessing the impact of restoring water quality on economic sectors that have significant role and importance in the local, regional and national economy;
- ✓ supporting the development of economic and financial instruments that may be effective in reaching environmental objectives;
- ✓ assessing the least costly way for the economy to achieve defined environmental objectives for water resources;
- ✓ assessing the economic impact of proposed programmes of measures aimed at improving water status; and
- ✓ assessing regions or water bodies where environmental objectives need to be made less stringent to account for economic and social impacts in a search for overall sustainability.

Several types of economic analysis need to be carried out for accomplishing listed objectives, such as:

- ✓ development of baseline socio-economic scenario for the basin, including description of the importance of water and water ecosystem use;
- ✓ cost-recovery analysis;
- ✓ cost-effectiveness analysis, and/or
- ✓ cost-benefit analysis.

This section provides summary of the economic analysis carried for development of the LOWMP.

8.2 OVERVIEW OF APPLIED ECONOMIC INSTRUMENTS FOR WATER MANAGEMENT

Economic instruments are a widely used tool in environmental protection policies in both developed and developing countries throughout the world. The key reason for implementing economic instruments is to send out a signal that the use of a resource imposes costs on others, i.e. some form of external costs which are not covered in the price of services or products. In essence, economic instruments increase the efficiency in resource use by decreasing demand and thus reducing damages, however at the same time generating revenues for further use for environmental resource management.

Albania and North Macedonia have developed economic instruments related to water resource management. Overview of the water-related economic instruments established in Albania and North Macedonia is shown in Table 8.1[50]. Applied economic instruments are divided in four categories:

- ✓ water service tariffs (fees);
- ✓ water use charges;
- ✓ emission charges; and
- ✓ product charges.

The fifth category refers to charges/fees as a consequence of water resources use under a concession agreement.

It should be pointed out that important differences exist in the level of the listed economic instruments between the two countries, as well as that at present the effectiveness of these instruments in not known.

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[50] Source: “Thematic Report on Socio-Economics of the Extended Drin River Basin; The Global Water Partnership – Mediterranean (GWP – Med), November 2017.

8.3 TARIFFS FOR WATER SUPPLY AND WASTEWATER MANAGEMENT

8.3.1 Tariff Setting and Operating Cost Recovery of Water Services

In both countries sharing the LOW water service tariffs are regulated by special national agencies – the Albanian Regulatory Authority of the Water Supply and Waste Water Disposal and Treatment Sector[51], and the Energy and Water Services Regulatory Commission of the Republic of North Macedonia[52]. Thus, tariffs for drinking water supply and wastewater collection and treatment are defined based on specific tariff-setting methodologies, which are based on legislative and regulatory provisions, and as such are obligatory for all service providers in the countries.

Table 8.1: Overview of Economic Instruments for Water Management in Albania and North Macedonia

Economic Instruments	Economic activities	Albania	North Macedonia
Water service fees/tariffs	Water supply	•	•
	Wastewater collection	•	•
	Wastewater treatment	•	•
	Irrigation	•	•
	Land drainage		•
Water use(r) charges	Water supply for human consumption		•
	Water supply for industry/production	•	•
	Irrigation		•
	Fish breeding/aquaculture	•	•
	Land drainage		•
	Livestock	•	
	Use of geothermal water	•	•
	Water used for cooling systems	•	
Emission charges	Untreated wastewater discharge		•
	Fertilizer and pesticide use		
Product charges	Electricity production	•	•
	Sand, gravel and stone exploitation	•	•
	Water bottling	•	•
	Alcoholic and non-alcoholic drinks	•	
	Phosphorous detergents		
Water use concession	Water tourism activities	•	•
	Lake/water transport		
	Use of ports		

Table 8.2 below provides an outline of average water supply and wastewater service tariffs (prices) in 2018 in LOW municipalities; average water service tariffs for both countries are also provided.

The total water service tariff of €0.67/m^3 (82.22 ALL/m^3) charged by the CPE in Pogradec is 29% lower than the national average, with an average water supply tariff of €0.37/m^3 (45.4 ALL/m^3) being 65% lower than, and wastewater management tariff of €0.30/m^3 (36.8 ALL/m^3) being 36% higher than the national average.

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51 http://www.erru.al/index.php?lang=2

52 https://www.erc.org.mk/Default_en.aspx

Table 8.2: Water service tariffs for households and industry in LOW municipalities[53]

Water tariff (Euro/m3)	2018					
	Podradec	Ohrid	Struga	Debrca	AL average	NMK average
Households						
Total water tariff	0.67	0.70	0.97	0.42	0.80	0.61
Water supply	0.37	0.56	0.57	0.36	0.61	0.43
WWM	0.30	0.14	0.40	0.06	0.19	0.18
Industry and public sector						
Total water tariff	0.91	0.70	0.97	0.42		0.61
Water supply	0.61	0.56	0.57	0.36		0.43
WWM	0.30	0.14	0.40	0.06		0.18

The situation is somewhat different on the other side of the lake in North Macedonia, where the CPEs in Ohrid and Struga charge higher total water service tariffs than the national average (e.g. in Struga the total water service tariff of €0.97/m^3 (59.5 MKD/m^3) is nearly 40% higher and the wastewater tariff being even 56% higher than the national averages). On the other hand, Debrca municipality charges significantly lower tariffs that the national averages.

Another important aspect is the marked difference between tariffs charged to households vs. industry and public institutions in Pogradec. Finally, evidently Struga has by far highest water service prices in the region for both households and industry.

Table 8.3: Operational and Financial Indicators of the Water Service Providers in the LOW54

Index	2015		
	Pogradec	Ohrid/Struga	Debrca
Water Coverage (%)	87.0%	91.0%	47.0%
Water Coverage – Household Connections (%)	87.0%	91.0%	47.0%
Sewerage Coverage (%)	72.0%	89.7%	15.1%
Average Revenue W&WW (US$/m3 water sold)	0.65	0.55	0.33
Unit Operational Cost Water and Wastewater (W&WW) (US$/m3 sold)	0.37	0.62	0.36
Staff Water/000 Water pop served (#/000 W pop served)		2.55	0.95
Collection Period (days)		1,077.15	505.08
Collection ratio (%)	100%	100%	100%
Operating Cost Coverage (ratio)	1.78	0.88	0.93
Water Consumption (liters/person/day)	75.0	180/80	276.0
Non Revenue Water (%)	59.0%	65.3%	13.3%
Non Revenue Water (m3/km/day)	28.6	57.1	1.2
Water sold that is metered (%)	96.8%	85.0%	95.5%

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[53] Sources: Albanian Regulatory Authority of the Water Supply and Waste Water Disposal and Treatment Sector (2018); Energy and Water Services Regulatory Commission of the Republic of North Macedonia (2018). International Benchmarking Network for Water and Sanitation Utilities (IBNET), 2015/18.

[54] Source: International Benchmarking Network for Water and Sanitation Utilities (IBNET), 2015.

Selected operational and financial indicators for 2015 of the four CPEs providing W&WW management services in the LOW are presented in Table 8.3 and Fig. 8.1. Most important elements from presented data are the differences in water consumption (both total and residential), non-revenue water (as a percentage of the total water supply), tariff collection period, and above all the operating cost ratio (revenues vs. operating costs).

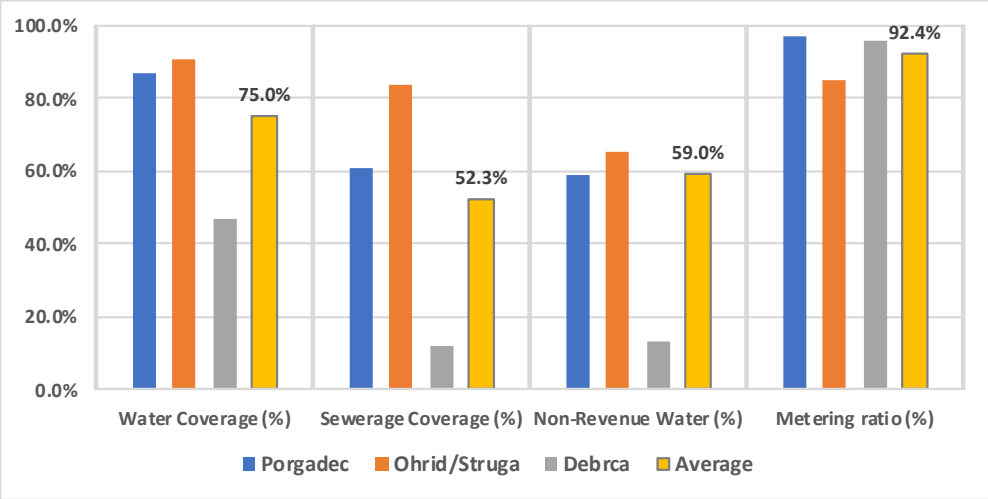

Figure 8.1: Operating Indicators of Water Service Providers in the LOW

Thus, as regards cost-recovery for the W&WW service it is concluded that, except for Pogradec municipality, the tariffs levied to households and industry in the LOW (North Macedonia) enable operation of the service providers at a level of covering only the basic financial/service operating costs – O&M and replacements. That is, by and large a very small reserve is applicable for capital investments in development and extension of the infrastructure. Nevertheless, these are figures from 2015 and, as mentioned before, currently the water service tariffs in both countries are regulated and set based on methodology designed to progressively enable full cost-recovery.

8.3.2 Affordability of Water Service Tariffs

Affordability, or ability to pay, in general, is a function of income related to the cost of living, or expenses that need to be paid for a certain service against the benefits derived from the use of the service. Income is often used to estimate a community's socio-economic status and the related ability of residents to support utility costs. The most prevalent method of assessing household affordability involves determining the monthly/annual amount spent on services as a function of monthly/annual household income. Overview of analysis and results regarding assessment of the affordability of the local population in the LOW to bear the current costs of W&WW management is presented further.

When discussing W&WW affordability a thresholds value expressed as a percentage is applied on household income that determines the point at which the cost of water and wastewater services becomes unaffordable. Table 8.4 represents such threshold values used by various international organizations and the value established in North Macedonia.

Table 8.4: Water Service affordability Threshold Values

Organization	Threshold value*
World bank (2002)	3% – 5%
UK Government	3%
US Government (USEPA)	2.50%
Asian Development Bank (ADB)	5%
UNDP	3%
North Macedonia (regulator)	3%

% of average household income that can be spent on water and wastewater services

Further, for assessment of W&WW services affordability several factors need to be taken into consideration, such as average water consumption, service price, household size and type, average household income, household

income by different income groups, etc. The information regarding W&WW affordability presented herein are based on official statistical and other available data.

The share of current water service expenditures in the total household expenditures for several categories of household income is shown in Table 8.5.

Table 8.5: Share of Water Service Expenditures by Categories of Household income in the LOW

HH income categories (Euro/month)	WS+WWM expenses as % of HH monthly income			
	Podradec	Ohrid	Struga	Debrca
250	1.7%	4.0%	3.0%	2.7%
400	1.1%	2.5%	1.9%	1.7%
600	0.7%	1.7%	1.2%	1.1%
800	0.5%	1.3%	0.9%	0.8%
1,000	0.4%	1.0%	0.7%	0.7%

It is concluded that at present the average prices charged by CPEs for W&WW in LOW municipalities are affordable for the local population, except for households of the group with lowest income. Evidently, the recent increase of water service tariffs vs. affordability aspects is reflected in the water consumption patterns (see Tables 4.1 and 8.2).

Finally, projections regarding future household affordability to pay for W&WW services are directly related to projections of possible changes in water consumption, upgrade of the services, household size by types of households, and above all expected changes in household income. The last listed aspect is based on projections of expected GDP growth. In addition, perhaps a key influencing factor is whether required investments for increased/improved wastewater treatment will be included in future service costs. In such a case it can be expected that the consequent increase of the tariffs may lead to a situation where affordability of water services may become an issue for important groups of the local population. Thus, it is concluded that capital subsidies in the form of grants to cover major part of investment costs for modernization of the water services will have to be applied in the future too.

8.4 COST-BENEFIT ANALYSIS

8.4.1 Investment Costs of the Proposed Programme of Measures

Investment costs in the 2020 – 2031 period for implementing the measures specified in the PoM of this plan total € 236.2 million. Nearly 41% or €96.6 million will be spent on measures for control of urban wastewater discharge and storm overflows; 13.3% of the total (€31.4 mill) will be spent on measures for waste management improvement; 10.2% (€24.1 mill) on measures for control of agricultural sources of pollution; 9.4% (€22.3 mill) on control of irrigation withdrawals; 6% (€13.88 mill) on control of municipal water abstractions; 2.3% of the total (€5.4 mill) on fishery improvement measures; 16.7% (€39.4 mill) on other measures, of which €6 mill on remediation of contaminated industrial sites, €14.2 mill on flow diversion (Sateska river) and €19.2 mill on other anthropogenic pressure management measures (i.e. construction of boat docking stations); and 1.4% (€3.2 mill) on policy measures.

Given the importance of the measures for achieving the plan objectives, 74%, or €174.82 mill, are planned to be spent in the first 6-year implementation period and the remaining 26% in the second period (Table 8.6 and Fig. 8.2). 67% of the total costs (nearly €158 mill) are for measures in North Macedonia and 33% (€78.2 mill) for measures on the Albanian side of the watershed.

Table 8.6: Allocation of PoM Costs

Pressure addressed with KTM	Expenditure (€)		Sum (€) (2020-2031)	% of Total
	2020-2025	2026-2031		
1.1 - Point – Urban waste water + 2.1 - Diffuse - Urban runoff + 2.6 - Diffuse - Discharges not connected to sewer	€ 74,550,000	€ -	€ 74,550,000	31.6%
1.2 - Point – Storm overflows	€ -	€ 22,000,000	€ 22,000,000	9.3%
1.3 - Point – Non-IED plants	€ 2,000,000	€ -	€ 2,000,000	0.8%
1.6 - Point – Waste disposal + 5.3 - Litter or fly tipping	€ 21,455,000	€ 9,950,000	€ 31,405,000	13.3%
1.8 - Point - Aquaculture + 2.9 - Diffuse - Aquaculture	€ 150,000	€ -	€ 150,000	0.1%
2.2 - Diffuse – Agriculture	€ 13,950,000	€ 10,150,000	€ 24,100,000	10.2%
2.5 - Diffuse – Contam. industry sites	€ 1,500,000	€ 4,500,000	€ 6,000,000	2.5%
3.1 - Abstraction – Agriculture	€ 13,600,000	€ 8,700,000	€ 22,300,000	9.4%
3.2 – Abstraction – Water supply + 3.3 -- Abstraction industry	€ 7,790,000	€ 6,090,000	€ 13,880,000	5.9%
3.5 – Flow diversion – Hydropower	€ 14,220,000	€ -	€ 14,220,000	6.0%
5.1 - Introduced species and diseases	€ 1,250,000	€ -	€ 1,250,000	0.5%
5.2 - Exploitation/removal of animals	€ 4,000,000	€ -	€ 4,000,000	1.7%
7 - Other pressures (boating)	€ 19,150,000	€ -	€ 19,150,000	8.1%
Policy measures, research, knowledge	€ 1,200,000	€ -	€ 1,200,000	0.5%
Total	**€ 174,815,000**	**€ 61,390,000**	**€ 236,205,000**	**100%**
% of Total per period	74%	26%		

8.4.2 Expected benefits from Protection of Water Resources in the LOW

As outlined in Section 6 implementation of the LOWMP has four distinct objectives related to

- ✓ restoration of good status/quality of surface and ground waters;
- ✓ preventing deterioration of water resources already having a good status;
- ✓ reduction of chemical pollution of water resources; and
- ✓ achieving objectives related to protected areas. Accomplishment of these objectives, on the other hand, will bring about a number of benefits for the local population in the basin, but as well for the wider community.

Nevertheless, a significant amount of financial resources will need to be devoted for accomplishment of the benefits, which in the end is a question of making a decision for allocating the required funding. Such decisions that have unequal consequences for different stakeholders and affect the well-being of entire communities are better taken in the most informed way, i.e. through cost and benefit accounting. This environmental accounting approach has the precise purpose of ensuring that all the benefits and costs for natural resource protection are taken into account for the purpose of making informed and sustainable decisions.

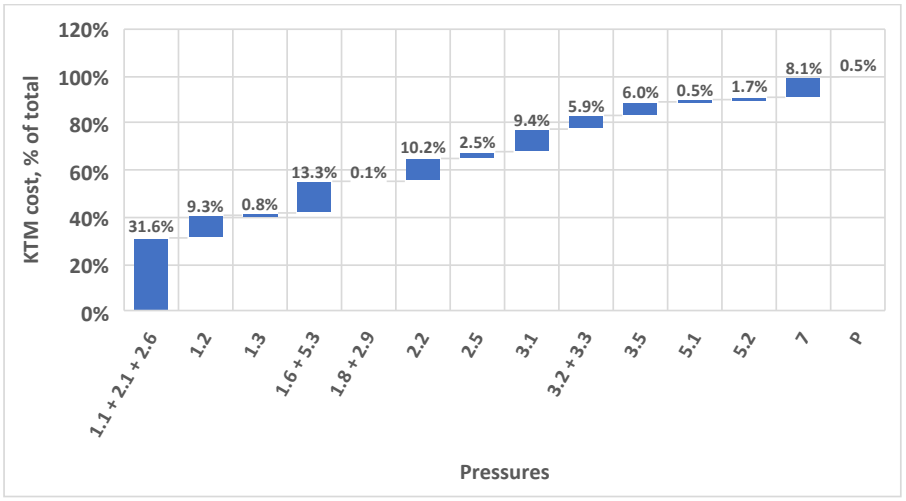

Figure 8.2: Distribution of PoM Costs

Thus, it is of highest importance to recognize the different values that people hold in terms of benefits from nature at the local, regional, national, and global level. These values have to do with how much people depend on the resource being protected, culture, income, and worldviews. The more dependent people are on natural resources for their livelihoods, the more they will care about productive functions stemming from these resources. On the other hand, tourists often value scenic beauty and biodiversity more than the locals, which in the case of the LOW is also of outmost importance to be recognized. Such benefits, or values, typically outweigh the costs of resource protection when assessed in monetary terms.

For these reasons the broad array of benefits expected to be accomplished with implementation of the LOWMP as a whole were assessed through the concept of valuing the ecosystem services provided by the natural and cultural capital of the LOW. Summary results from the valuation are presented in Table 8.7 below; detailed overview is provided in Supplement II.

A total of twelve Ecosystem Services (ES) provided by the Lake Ohrid watershed were valued using various economic techniques such as direct and indirect market price and avoided cost (direct market valuation approach), benefit transfer and travel cost (revealed preference approach), and contingent valuation (stated preference approach) methods. The range of valued ES is divided in ES of Lake Ohrid; ES of forests, protected and agricultural areas; and ES related to the entire watershed.

Table 8.7: Total Economic Value of LOW Ecosystem Services

Watershed part	Ecosystem Services	Service Type	Service value type (TEV approach)	Valuation method	Estimated ES value ($)	Period	% of Total
Lake Ohrid	Drinking water - households, industry	Provisioning	Use value - direct	Market price	$ 5,780,135	2016/17	2.0%
	Hydropower generation	Provisioning	Use value - direct	Market price	$ 55,525,470		18.8%
	Commercial fishery	Provisioning	Use value - direct	Market price	$ 1,016,506		0.3%
	Commercial boating	Provisioning	Use value - direct (NC)	Market price	$ 708,606		0.2%
Forests, Protected and Agriculture Areas	Raw materials -- timber, fuelwood	Provisioning	Use value - direct	Market price	$ 3,735,613	2016-2018	1.3%
	Food - game, fungi	Provisioning	Use value - direct	Market price	$ 5,774,725		2.0%
	Medicinal resources -- herbs	Provisioning	Use value - direct	Market price	$ 5,761,573		2.0%
	Agriculture production (crops)	Provisioning	Use value - direct	Market price	$ 17,480,000		5.9%
	Erosion prevention/soil protection	Regulating	Use value - indirect	Avoided cost	$ 346,531		0.1%
	CO2 sequestration	Regulating	Use value - indirect	Market price	$ 2,423,878		0.8%
Entire Watershed	Tourism and recreation	Cultural	Use value - direct (NC)	Travel cost	$ 191,438,339	2017/18	64.9%
	Existence/bequest/altruist value	Cultural	Non-use value	Contingent valuation	$ 5,114,937		1.7%
NC - non consumptive				**Total Value**	**$ 295,106,314**		100%
				Unit Value ($/ha)	**$ 2,102**		

The Total annual Economic Value (TEV) expressed in monetary units of the ecosystem services of the LOW in 2017[55] is $295.1 million. The unit value per area, taking into consideration the entire area of the watershed, equals $2,102/ha. Within this, the value of services of Lake Ohrid is $63.3 mill, or 21.4% of the total value; the value of services of forests, protected and agriculture areas within the watershed is $35.52 mill. (12% of the TEV); and the value of services that are related to the entire watershed is $196.55 mill, or 66.6% of the total value.

In summary, three of the twelve analyzed ES – Tourism and recreation, Hydropower and Agriculture – account for nearly 90% (89.6%) of the total estimated value. Of the remaining services, Drinking water, Food, Medicinal herbs and Existence/bequest, account for 2% of the total each.

The simplified cost-benefit analysis is based on the following data and assumptions:

- ✓ the time frame for the assessment is set to 15 years;
- ✓ the average expected inflation rate is set to 2.5%, assumed to be valid for both Albania and North Macedonia;
- ✓ the average US$ to Euro conversion rate for 2017/18 equals 0.85;
- ✓ two different discount rates were used: a minimum of 3%, as a case of solely accounting for minimum projected inflation, and a 5% rate;
- ✓ the total sum of PoM costs are included, distributed as equal annual expenditures over the two implementation periods;
- ✓ annual operating costs for the new/improved infrastructure systems that will results from the PoM are assumed to equal 2% of the investments made in the previous years; and
- ✓ the values only of the water quality-related ES are taken into consideration: Drinking water provision, Commercial fishery, Agriculture production, Tourism and recreation and Existence value. The benefits from implementation of the plan are assumed to take 6 years to manifest, i.e. the first implementation period, after which a uniform annual 2% value increase is assumed. The logic behind this rather conservative approach is that implementing the PoM, which is focused on restoration and protection of water resources in the watershed, and assuming that other risks are managed will, as a minimum, result in sustaining the current value of the analyzed water quality-related ecosystem services.

The analysis shows that the benefits that implementation of the plan would bring over the next 15 years are 8.4 to 8.7 times higher than the costs when different discount rates are used (Table 8.8).

Table 8.8: Summary Results of the Cost-Benefit Analysis

Cost or benefits	3% Discount rate	5% Discount rate
PV of costs	€ 268,046,819	€240,794,500
PV of benefits	€2,336,887,820	€2,022,248,415
B/C ratio	8.7	8.4

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[55] Due to data availability the analysis are for the period 2016 – 2018. However, all valued ecosystem services are on an annual basis, thus 2017 is assumed as an 'average year'.

9 PUBLIC PARTICIPATION

Consistent with article 14 of the WFD, it is a common policy to encourage the active involvement of all interested parties in the processes of production, review and updating of river basin management plans. Effective public participation brings greater transparency, openness and creativity to decision-making. Public participation can operate at the level of individual persons and on a broader sectoral basis – e.g. comments, objections or actions by a concerned individual person or by sectoral representatives of industry, businesses, agriculture, environmental NGOs, etc. In general, efforts to promote public participation in implementation of the WFD are guided by the following objectives:

- ✓ providing information to all interested parties;
- ✓ improving decision-making by gaining the benefit of the knowledge, experience and initiatives of stakeholders;
- ✓ promoting constructive dialogue between interested parties and bringing greater transparency, openness and creativity to decision-making;
- ✓ assisting interested parties to influence decisions;
- ✓ increasing public awareness of water management issues; and
- ✓ increasing public involvement and understanding of, and support for, decision-making processes thereby improving effective implementation.

The concept and practice of public participation in relation to a wide spectrum of decision-making by public authorities is established in both Albania and North Macedonia. Interested parties have a high degree of access to information and to the decision-making processes. A programme of actions to promote public participation should include a broad range of measures to provide for public information and consultation and to encourage and facilitate the direct involvement of a broad range of interested parties. Thus, from the onset of the LOWMP preparation, i.e. during the Inception Phase, stakeholder mapping, engagement and consultation activities were planned and initiated. The stakeholder mapping effort resulted in identification of the following stakeholder groups:

- ✓ national policy makers (ministries and national policy-making bodies);
- ✓ implementing and executing bodies (local government units, generation companies – KESH/ELEM, etc.);
- ✓ likely beneficiaries (e.g. local businesses, water transport service providers, individual fishermen, tourists and other recreational users);
- ✓ potentially adversely affected groups;
- ✓ disproportionately represented groups (above all rural women); and
- ✓ organized interest groups and external stakeholders.

In line with international best practices, the stakeholder engagement plan/model selected the following public participation activities as relevant and applicable during the LOWMP development:

- ✓ semi-structured interviews;
- ✓ participatory focus group discussions; and
- ✓ formal consultations on the draft LOWMP methodology and draft Programme of Measures.

Following the devised plan, the following public participation and consultation activities took place:

- ✓ Inception Workshop, organized in Ohrid on May 15, 2018, which brough together over 30 participants from responsible ministries, local government units, public enterprises, development agencies, research organizations, and NGOs from both countries. Aspects regarding the EU WFD, the LOWMP development methodology as well as the Draft Inception Report were presented and discussed during the workshop. A number of valuable comments and recommendations were given by the participants, based on which a Final Inception Report was prepared;

Figure 9.1: Inception Workshop on May 15, 2018 in Ohrid

- ✓ over 20 direct meetings (semi-structured interviews) with local government units, public enterprises, executive authorities and other responsible organizations on local level were conducted during the succeeding period (May – December 2018) dedicated to characterization of the LOW. These meetings decisively contributed to collecting valuable data and information for the LOWMP preparation, as well as guided the identification of particular pressures on the watershed water resources;
- ✓ a specific and particularly important public participation event related to the LOWMP development represents the survey that was conducted in the LOW region in August/September of 2018. The goal of the survey was to collect data necessary for valuation of the LOW ecosystem services. Two questionnaires were developed for the purpose, focused on gathering an insight into the end-users' (stakeholders') perception of the values and benefits arising from the natural characteristics of the LOW, the awareness of the pressures impacting the status and quality of basin's water resources, as well as for determining their willingness-to-pay for improved protection and overall conditions in the LOW. The survey took place in all administrative units within the Pogradec municipality in Albania and the three municipalities of North Macedonia. It was carried out by a group of selected local residents (surveyors) from Pogradec, Ohrid and Struga as 'direct interview with respondents'-type of survey and covered 220 residents of the LOW and 212 tourist, both domestic and foreign. The invaluable information gathered with the survey, along with the analysis, are presented in detail in Supplement II – Valuation of Ecosystem Services of the Lake Ohrid Watershed;
- ✓ two Focus Group Meetings (FGM) were organized in Ohrid (May 14, 2019) and one in Struga (May 15, 2019). The FGMs gathered over 30 stakeholders representing tourism service providers (hotel and restaurant owners), tourism agencies, local government representatives, Port Authority representatives from Ohrid, and NGOs. Apart from presentation of the key pressures, the meetings also involved structured discussions on participants' perception of the pressures, as well as their opinion regarding possible solutions that would be beneficial and acceptable for the local population and businesses. The discussion assertively contributed to the preparation of plan's PoM;
- ✓ on January 28, 2020 the Draft LOWMP was presented to the Drin CORDA Expert Working Group and on January 30 to the Drin Core Group at an event organized by the GWP-Med in Tirana;
- ✓ in March 2020 the Draft LOWMP was published on the MoEPP web page. Representatives of North Macedonia ministries and other stakeholders were invited to review the plan and submit their comments;
- ✓ on June 23, 2020 the Albanian Water Resource Management Agency (AMBU) has distributed the Draft LOWMP to representatives of country's Transboundary Water Administration Commission. Commission members have been asked to provide their opinion on the plan on behalf of the institution they lead. As a follow up the Albanian Ministry for Europe and Foreign Affairs and the Ministry of Agriculture and Rural Development agreed with the plan through written statements. The Ministry of Tourism and Environment (MoTE) and AMBU have provided comments on the plan, which have been taken into consideration for preparation of the Final LOWMP;
- ✓ on 28th of September 2020, the draft Lake Ohrid Watershed Management Plan was presented at a national on-line consultation meeting organized by the Ministry of Environment and Physical Planning of North Macedonia, involving approximately 30 representatives from the competent Ministries, public institutions, local government, civil and scientific society in North Macedonia. At the online consultation meeting, participants recognized the value of the LOWMP as a necessary step towards sustainably managing this important ecosystem, addressing the Lake's common challenges and promoting cross sectoral cooperation within each riparian country in the framework of the EU Water Framework Directive; and
- ✓ on 27th of November 2020, the draft Lake Ohrid Watershed Management Plan was presented at an on-line consultation meeting of the Lake Ohrid Bilateral Committee, organized by the Mayor of Ohrid and involving approximately 15 participants — Mayors of Pogradec and Ohrid, other local government representatives, representatives from the competent Ministries, and civil society organizations in Albania and North Macedonia.

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Appendix A

Population in the LOW

Doc. No. P0006769-1-H6 Rev. 0 - November 2020

Annex 1: LOW - Population

Municipality	Administrative Unit	Settlement	Female	Male	Total Settlement	Total Municipality	Year	% of LOW population	Area (km2)*	Population density (cap/km2)	% Urban	% Rural
Pogradec	**Buçimas**	Buçimas Gështenjas Gurras Rëmenj Tushemisht Vërdovë	7,687	8,000	15,687	**51,716**	2011	**39%**	44.7	351	0%	100%
	Çerravë	Alarup Çerravë Grabovicë Leshnicë Lumas Peshkëpi Qershizë	3,434	3,575	7,009		2011		56.5	124	0%	100%
	Dardhas	Dardhas Lekas Stropckë	1,069	1,113	2,182		2011		54.0	40	0%	100%
	Pogradec	Pogradec Baçallëk Kodras	10,216	10,632	20,848		2011		4.5	4,620	34%	66%
	Hudenisht	Buqezë Çervenakë Lin Memelisht Piskupat Udenisht	2,935	3,055	5,990		2011		46.5	129	0%	100%
Debrca	N/A	Arbinovo	13	6	19	**3,994**	2015	**3%**	405.0	10		100%
		Belchishta	157	163	320							
		Botun	72	94	166							
		Brezhani	12	11	23							
		Dolno Sredorechie	20	21	42							
		Godivje	34	34	67							
		Gorentsi	95	100	195							
		Gorno Sredorechie	5	5	10							
		Grko Pole	11	11	22							
		Izdeglavje	53	47	100							
		Klimeshtani	18	24	42							
		Laktinje	31	29	60							
		Leshani	170	184	354							
		Mesheishta	296	274	570							
		Mramorets	4	2	6							
		Novo Selo	27	23	50							
		Orovnik	157	165	322							
		Ozdoleni	19	15	34							
		Pesochani	37	33	70							
		Slatino	59	59	118							
		Slatinski Chiflik	4	4	8							
		Slivovo	7	5	12							
		Soshani	5	6	11							
		Trebenishta	192	184	375							
		Tsrvena Voda	7	10	17							
		Turje	5	7	12							
		Velmej	198	176	374							
		Volino	165	173	338							
		Vrbjani	25	18	42							
		Zlesti	109	106	215							
Ohrid	N/A	Dolno Lakocherej	255	258	513	**51,850**	2015	**39%**	381.0	136	75%	25%
		Dolno Konjsko	332	345	677							
		Eleshets	30	34	64							
		Elshani	262	286	549							
		Gorno Lakocherej	240	239	479							
		Konjsko	9	11	20							
		Kosel	268	277	545							
		Kuratitsa	151	153	303							
		Lagadin	9	9	19							
		Leskoets	1,201	1,213	2,414							
		Livoishta	81	85	166							
		Ljubanishta	72	87	159							
		Naselba Istok	54	55	109							
		Ohrid	19,881	19,216	39,097							
		Openitsa	28	26	54							
		Orman	47	49	97							
		Peshtani	620	613	1,233							
		Plakje	2	2	4							
		Podmole	146	162	308							
		Racha	472	499	970							
		Ramne	290	298	588							
		Rasino	2	6	7							
		Rechitsa	0	0	0							
		Shipokno	3	2	5							
		Sirula	4	6	9							
		Skrebatno	3	3	6							
		Sveti Stefan	52	52	104							
		Svinishta	30	30	60							
		Trpejtsa	138	144	282							
		Vapila	51	53	104							
		Velestovo	26	23	49							
		Velgoshti	1,418	1,428	2,846							
		Zavoj	7	5	11							
Struga		Frangovo	883	932	1,815	**24,498**	2015	**19%**	54.8	447	71%	29%
		Kalishta	615	615	1,229							
		Mali Vlaj	35	39	74							
		Radolishta	1,626	1,629	3,255							
		Radozhda	424	420	843							
		Struga	8,702	8,580	17,282							
TOTAL in LOW			**65,813**	**66,245**		**132,059**		**100%**	**1,047**	**126**	**48%**	**52%**

** Water bodies excluded*

Appendix B
Population Water Supply Coverage

Doc. No. P0006769-1-H6 Rev. 0 - November 2020

Annex 2: LOW - Population Water Supply Coverage

Municipality	Administrative Unit	Settlement	Population	Total Municipality	Water supply by PUC	Water supply by community system	Self water supply
Pogradec	Buçimas	Buçimas	15,687	51,716	80%		20%
		Gështenjas					
		Gurras					
		Rëmenj					
		Tushemisht					
		Vërdovë					
	Çerravë	Alarup	7,009		80%		20%
		Çerravë					
		Grabovicë					
		Leshnicë					
		Lumas					
		Peshkëpi					
		Qershizë					
	Dardhas	Dardhas	2,182		80%		20%
		Lekas					
		Stropckë					
	Pogradec	Pogradec	20,848		98%		2%
		Baçallëk					
		Kodras					
	Hudenisht	Buqezë	5,990		80%		20%
		Çervenakë					
		Lin					
		Memelisht					
		Piskupat					
		Hudenisht					
				Population Total	**45,125**	**0**	**6,591**
				% of population in municipality	*87%*	*0%*	*13%*
Debrca	N/A	Arbinovo	19	3,994	95%		5%
		Belchishta	320		95%		5%
		Botun	166		95%		5%
		Brezhani	23			80%	20%
		Dolno Sredorechie	42		95%		5%
		Godivje	67			80%	20%
		Gorentsi	195		95%		5%
		Gorno Sredorechie	10		95%		5%
		Grko Pole	22		95%		5%
		Izdeglavje	100		95%		5%
		Klimeshtani	42			80%	20%
		Laktinje	60			80%	20%
		Leshani	354		95%		5%
		Mesheishta	570			80%	20%
		Mramorets	6			80%	20%
		Novo Selo	50		95%		5%
		Orovnik	322		95%		5%
		Ozdoleni	34			80%	20%
		Pesochani	70			80%	20%
		Slatino	118			80%	20%
		Slatinski Chiflik	8			80%	20%
		Slivovo	12			80%	20%
		Soshani	11			80%	20%
		Trebenishta	375		95%		5%
		Tsrvena Voda	17			80%	20%
		Turje	12			80%	20%
		Velmej	374			80%	20%
		Volino	338			80%	20%
		Vrbjani	42			80%	20%
		Zlesti	215			80%	20%
				Population Total	*187629%*	**1,615**	**503**
				% of population in municipality	*47%*	*40%*	*13%*
Ohrid	N/A	Dolno Lakocherej	513	51,850		80%	20%
		Dolno Konjsko	677		95%		5%
		Eleshets	64		95%		5%
		Elshani	549				100%
		Gorno Lakocherej	479		95%		5%
		Konjsko	20				100%
		Kosel	545				100%
		Kuratitsa	303				100%
		Lagadin	19		95%		5%
		Leskoets	2,414		95%		5%
		Livoishta	166		95%		5%
		Ljubanishta	159		95%		5%
		Naselba Istok	109		95%		5%
		Ohrid	39,097		95%		5%
		Openitsa	54				100%
		Orman	97		95%		5%
		Peshtani	1,233		95%		5%
		Plakje	4				100%
		Podmole	308			80%	20%
		Racha	970		95%		5%
		Ramne	588		95%		5%
		Rasino	7				100%
		Rechitsa	0				100%
		Shipokno	5				100%
		Sirula	9				100%
		Skrebatno	6				100%
		Sveti Stefan	104		95%		5%
		Svinishta	60				100%
		Trpejtsa	282		95%		5%
		Vapila	104		95%		5%
		Velestovo	49				100%
		Velgoshti	2,846		95%		5%
		Zavoj	11				100%
				Population Total	**46,937**	**656**	**4,257**
				% of population in municipality	*91%*	*1.3%*	*8.2%*
Struga		Frangovo	1,815	24,498		80%	20%
		Kalishta	1,229		60%		40%
		Mali Vlaj	74		95%		5%
		Radolishta	3,255		95%		5%
		Radozhda	843		95%		5%
		Struga	17,282		95%		5%
				Population Total	**21,119**	**1,452**	**1,927**
				% of population in municipality	*86%*	*6%*	*8%*
TOTAL in LOW				**132,059**	**115,058**	**3,723**	**13,277**
				% of population in LOW	*87%*	*3%*	*10%*

Municipality	Administrative Unit	Population	Population connected to central WS system	Number of HH connections	Number of comm/ind connections	Total number of connections	Total water input volume (m3/year)	Billed household consumption (m3/year)	Billed comm/ind consumption (m3/year)	Total billed consumption (m3/year)	Non-revenue water (m3/year)	Unit water production (lcd)	Unit water consumption (lcd)	Non-revenue vs. total water input ratio
Pogradec	**Buçimas**	15,687	45,125	11,571			2,684,738			1,663,549		163	62	62%
	Çerravë	7,009												
	Dardhas	2,182												
	Pogradec	20,848												
	Hudenisht	5,990												
Debrca	N/A	3,994	1,876	1,051	22	1,073	217,614	163,347	25,419	188,766	28,848	318	276	13.3%
Ohrid	N/A	51,850	46,937	29,400	2,301	31,701	8,916,955	2,538,312	552,816	3,091,128	5,825,827	520	180	65.3%
Struga	N/A	24,498	21,119	14,150	562	14,711	1,771,346	486,222	132,964	619,187	1,152,160	230	80	65.0%
TOTAL in LOW		**132,059**	**115,058**	**56,171**		**47,485**	**13,590,653**	**3,187,881**	**711,199**	**5,562,630**		**324**	**132**	**59.1%**

Appendix C

Wastewater Management in the LOW

Doc. No. P0006769-1-H6 Rev. 0 - November 2020

Annex 3: LOW - Waste Water Management

Municipality	Administrative Unit	Settlement	Population	Total Municipality	Waste water collection by PUC	Septic tanks	WWTP	WB Name
		Buçimas						Podgradec
		Gështenjas						Podgradec
	Buçimas	Gurras	15,687		80%	20%	WWTP Tushemisht	Podgradec
		Rëmenj						Podgradec
		Tushemisht						Podgradec
		Vërdovë						Podgradec
		Alarup						R-Cerave
		Çerravë						R-Cerave
		Grabovicë						R-Cerave
	Çerravë	Leshnicë	7,009			100%	N/A	R-Cerave
		Lumas						R-Cerave
		Peshkëpi						R-Cerave
Pogradec		Qershizë		**51,716**				R-Cerave
		Dardhas						R-Cerave
	Dardhas	Lekas	2,182			100%	N/A	R-Cerave
		Stropckë						R-Cerave
		Pogradec						Podgradec
	Pogradec	Baçallëk	20,848		90%	10%	WWTP Tushemisht	Podgradec
		Kodras						R-Cerave
		Buqezë						Lin
		Çervenakë						Udenisht
	Hudenisht	Lin	5,990			100%	N/A	Lin
		Memelisht						Udenisht
		Piskupat						Lin
		Hudenisht						Udenisht
				Population Total	**31,313**	**20,403**	**31,313**	
				% of population in municipality	*61%*	*39%*	*61%*	
		Arbinovo	19			100%		R-Sateska 1
		Belchishta	320		80%	20%	Own WWTP	R-Sateska 1
		Botun	166			100%		R-Sateska 2
		Brezhani	23			100%		R-Sateska 1
		Dolno Sredorechie	42			100%		R-Sateska 1
		Godivje	67			100%		R-Sateska 1
		Gorentsi	195			100%		HM-Sateska 3
		Gorno Sredorechie	10			100%		R-Sateska 1
		Grko Pole	22			100%		R-Sateska 1
		Izdeglavje	100			100%		R-Sateska 1
		Klimeshtani	42			100%		R-Sateska 2
		Laktinje	60			100%		R-Sateska 1
		Leshani	354			100%		R-Sateska 1
		Mesheishta	570			100%		R-Sateska 2
Debrca	N/A	Mramorets	6	**3,994**		100%		R-Sateska 1
		Novo Selo	50			100%		R-Sateska 1
		Orovnik	322		60%	40%	Vranishta WWTP	HM-Sateska 3
		Ozdoleni	34			100%		R-Sateska 1
		Pesochani	70			100%		R-Sateska 1
		Slatino	118			100%		R-Sateska 1
		Slatinski Chiflik	8			100%		R-Sateska 1
		Slivovo	12			100%		R-Sateska 1
		Soshani	11			100%		R-Sateska 1
		Trebenishta	375			100%		HM-Sateska 3
		Tsrvena Voda	17			100%		R-Sateska 1
		Turje	12			100%		R-Sateska 1
		Velmej	374			100%		R-Sateska 1
		Volino	338			100%		HM-Sateska 3
		Vrbjani	42			100%		R-Sateska 1
		Zlesti	215			100%		R-Sateska 1
				Population Total	**449**	**3,545**	**449**	
				% of population in municipality	*11%*	*89%*	*11%*	
		Dolno Lakocherej	513		100%	0%	Vranishta WWTP	R-Koselska 2
		Dolno Konjsko	677		100%	0%	Vranishta WWTP	Velidab
		Eleshets	64		80%	20%	Vranishta WWTP	Velidab
		Elshani	549		80%	20%	Vranishta WWTP	Velidab
		Gorno Lakocherej	479			100%		R-Koselska 2
		Konjsko	20			100%		Velidab
		Kosel	545			100%		R-Koselska 2
		Kuratitsa	303			100%		R-Koselska 2
		Lagadin	19		100%		Vranishta WWTP	Velidab
		Leskoets	2,414		30%	70%	Vranishta WWTP	Sushica
		Livoishta	166			100%		R-Koselska 2
		Ljubanishta	159			100%		Velidab
		Naselba Istok	109		50%	50%	Vranishta WWTP	Studenchiski kanal
		Ohrid	39,097		92%	8%	Vranishta WWTP	Studenchiski kanal
		Openitsa	54			100%		R-Koselska 2
		Orman	97			100%		R-Koselska 2
Ohrid	N/A	Peshtani	1,233	**51,850**	100%		Vranishta WWTP	Velidab
		Plakje	4			100%		R-Koselska 1
		Podmole	308		30%	70%	Vranishta WWTP	HM-Sateska 3
		Racha	970		50%	50%	Vranishta WWTP	Studenchiski kanal
		Ramne	588			100%		Sushica
		Rasino	7			100%		R-Koselska 2
		Rechitsa	0			100%		R-Koselska 1
		Shipokno	5			100%		Velidab
		Sirula	9			100%		R-Koselska 2
		Skrebatno	6			100%		R-Koselska 2
		Sveti Stefan	104			100%		Velidab
		Svinishta	60			100%		R-Koselska 1
		Trpejtsa	282			100%		Velidab
		Vapila	104			100%		R-Koselska 2
		Velestovo	49			100%		Velidab
		Velgoshti	2,846		100%		Vranishta WWTP	Sushica
		Zavoj	11			100%		R-Koselska 2
				Population Total	**43,104**	**8,747**	**43,104**	
				% of population in municipality	*83%*	*17%*	*83%*	
		Frangovo	1,815			100%		Kalishta
		Kalishta	1,229		80%	20%	Vranishta WWTP	Kalishta
		Mali Vlaj	74			100%		Kalishta
Struga		Radolishta	3,255	**24,498**	100%	0%	Vranishta WWTP	Struga/Drim
		Radozhda	843			100%		Radozhda
		Struga	17,282		95%	5%	Vranishta WWTP	Struga/Drim
				Population Total	**20,656**	**3,842**	**20,656**	
				% of population in municipality	*84%*	*16%*	*84%*	
TOTAL in LOW				**132,059**	**95,521**	**36,537**	**95,521**	
				% of population in LOW	*72%*	*28%*	*72%*	

Water Body			Population			Tourists (max daily)			Unit load (BOD)		Load to WBs (kg BOD/day)		
No.	Type	Name	Total	Connected to WWTP	Disch. in septic tanks	Total	Connected to WWTP	Disch. in septic tanks	Residential (g/cap/day)	Tourists (g/cap/day)	From connected to WWTP	From septic tanks	Total
Lake Water Bodies													
1	L	L-Radozhda	843	0	843	1,630	0	1,630	69	60	0.0	109.2	109.2
2	L	L-Kalishta	3,118	984	2,134	929	0	929	69	60	6.8	142.1	148.9
3	L	L-Struga-Black Drin	20,537	0	20,537	1,410	0	1,410	69	60	0.0	1,051.2	1,051.2
4	L	L-Sateska											
5	L	L-Koselska											
6	AWB	L- Studenchishki kanal	40,176	147	40,029	2,618	1,309	1,309	69	60	8.9	1,988.4	1,997.3
7	L	L-Velidab	3,161	1,241	1,920	10,546	5,147	5,399	69	60	39.4	319.5	358.9
8	L	L-Bay of St. Naum											
9	L	L-Tushemisht											
10	L	L-Pogradec	36,532	31,313	5,219	1,850	1,480	370	69	60	224.9	267.6	492.6
11	L	L-Udenisht	2,994	0	2,994				69	60	0.0	144.6	144.6
12	L	L-Lin	3,540	0	3,540	150	0	150	69	60	0.0	177.3	177.3
13	L	L-Lake Ohrid-Pelagic											
River Water Bodies													
1	R	R-Sateska 1	1,986	193	1,793				69	60	1.3	86.6	87.9
2	R	R-Sateska 2	778	256	522				69	60	1.8	25.2	27.0
3	HMWB	R-Sateska 3	1,538	0	1,538	569	85	483	69	60	0.5	94.6	95.1
4	R	R-Koselska 1	67	0	67				69	60	0.0	3.2	3.2
5	R	R-Koselska 2	2,294	39,979	-37,685	2,369	0	2,369	69	60	275.9	-1,720.7	-1,444.8
6	R	R-Cerave	8,100	0	8,100	616	0	616	69	60	0.0	417.1	417.1
7	R	R-Sushica	6,394	504	5,890				69	60	3.5	284.5	288.0
		Total	**132,058**	**74,615**	**57,443**	**22,685**	**8,021**	**14,664**			**563.0**	**3,390.4**	**3,953.3**
			100%	*56.5%*	*43.5%*	*100%*	*35.4%*	*64.6%*			*14.2%*	*85.8%*	*100%*

Appendix D

Key Type Measures

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APPENDIX D: Key Type Measures

1 Construction or upgrades of wastewater treatment plants.

2 Reduce nutrient pollution from agriculture.

3 Reduce pesticides pollution from agriculture.

4 Remediation of contaminated sites (historical pollution including sediments, groundwater, soil).

5 Improving longitudinal continuity (e.g. establishing fish passes, demolishing old dams).

6 Improving hydromorphological conditions of water bodies other than longitudinal continuity (e.g. river restoration, improvement of riparian areas, etc.).

7 Improvements in flow regime and/or establishment of ecological flows.

8 Water efficiency, technical measures for irrigation, industry, energy and households.

9 Water pricing policy measures for the implementation of the recovery of cost of water services from households.

10 Water pricing policy measures for the implementation of the recovery of cost of water services from industry.

11 Water pricing policy measures for the implementation of the recovery of cost of water services from agriculture.

12 Advisory services for agriculture.

13 Drinking water protection measures (e.g. establishment of safeguard zones, buffer zones etc.).

14 Research, improvement of knowledge base reducing uncertainty.

15 Measures for phasing-out of emissions, discharges and losses of Priority Hazardous Substances or for reduction of emissions and losses of Priority Substances.

16 Upgrades or improvements of industrial wastewater treatment plants (including farms).

17 Measures to reduce sediment from soil erosion and surface run-off.

18 Measures to prevent or control the adverse impacts of invasive alien species and introduced diseases.

19 Measures to prevent or control the adverse impacts of recreation including angling.

20 Measures to prevent or control the adverse impacts of fishing and other exploitation/removal of animal and plants.

21 Measures to prevent or control the input of pollution from urban areas, transport and built infrastructure.

22 Measures to prevent or control the input of pollution from forestry.

23 Natural water retention measures.

24 Adaptation to climate change.

25 Measures to counteract acidification.

Maps

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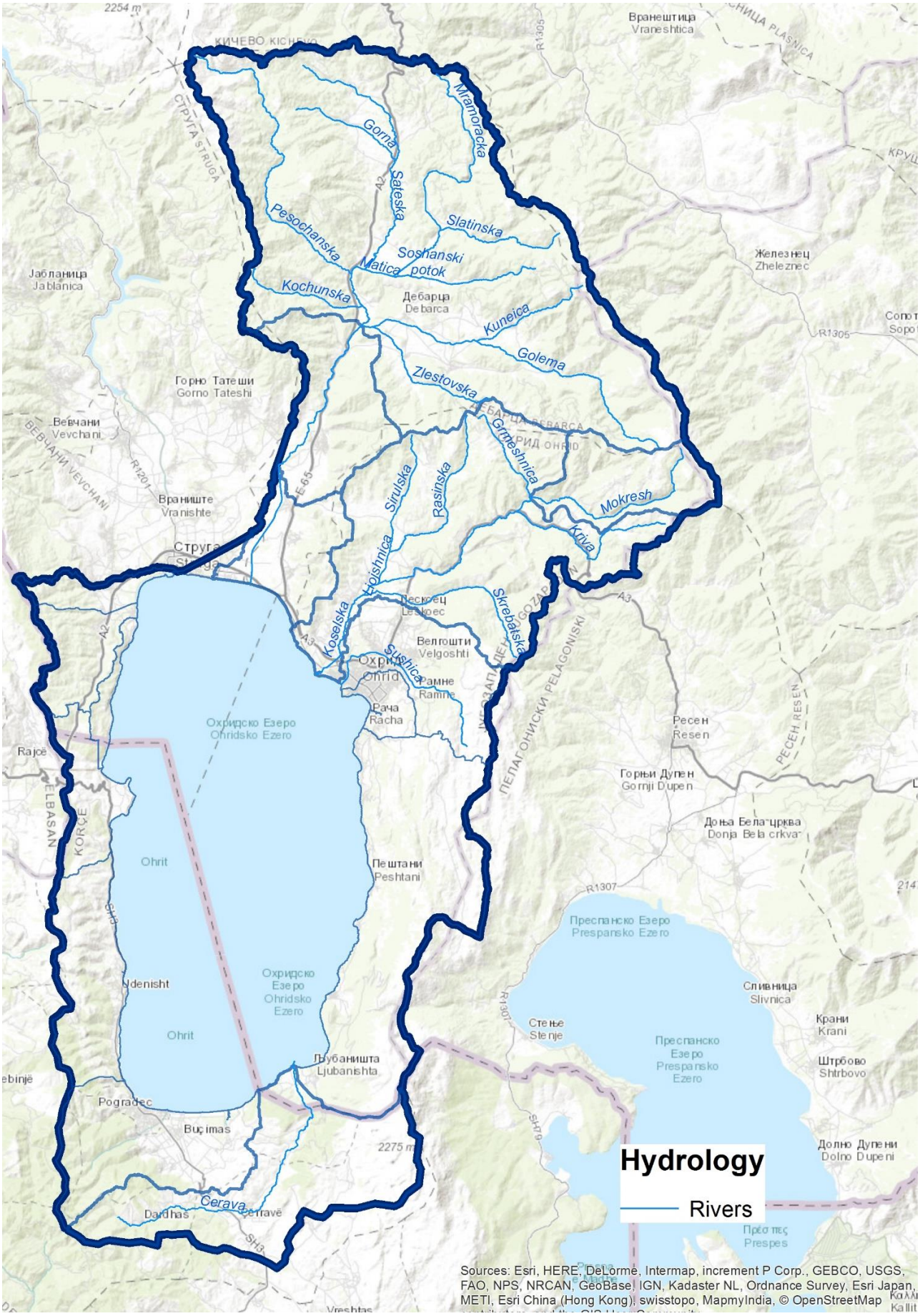
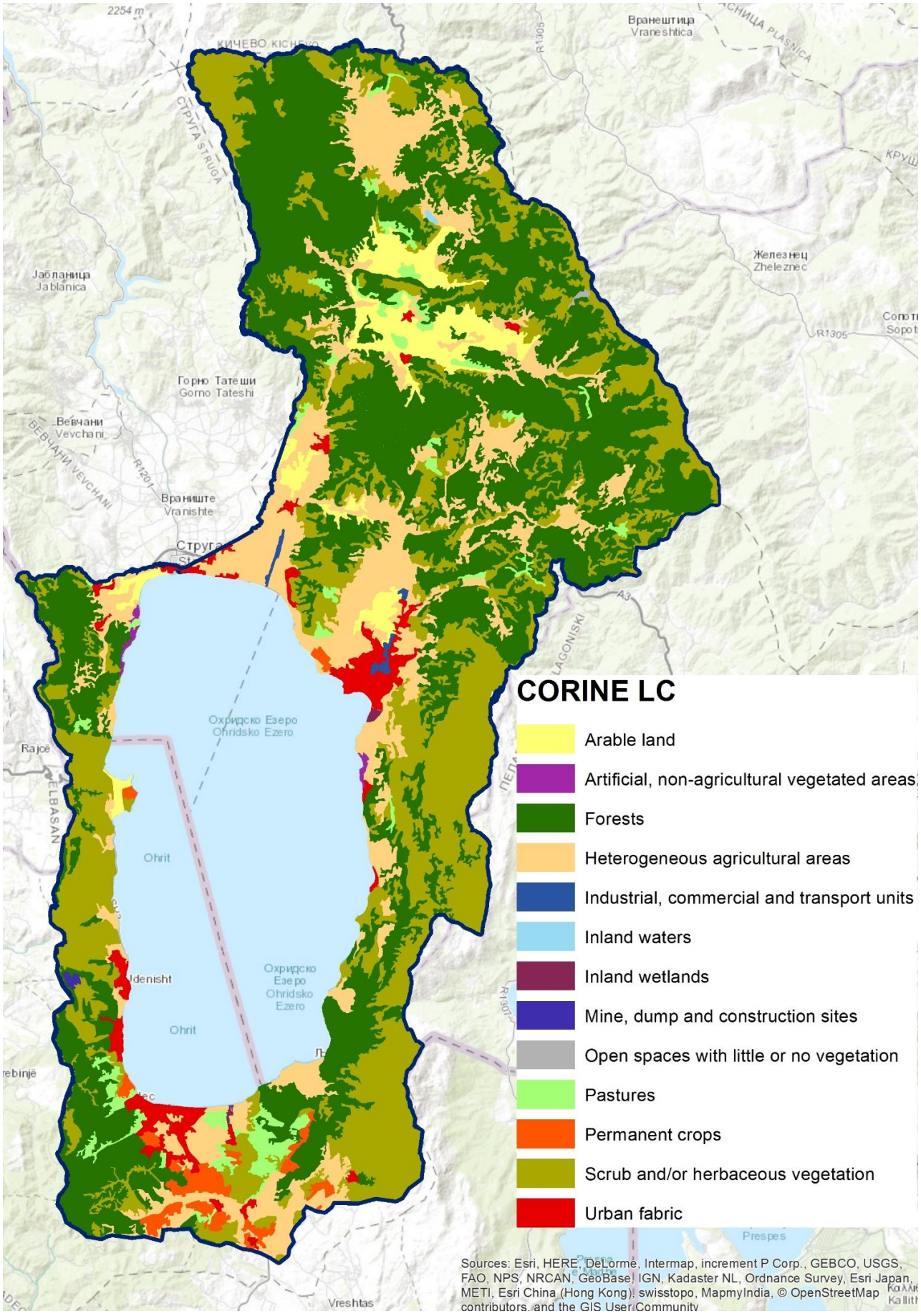
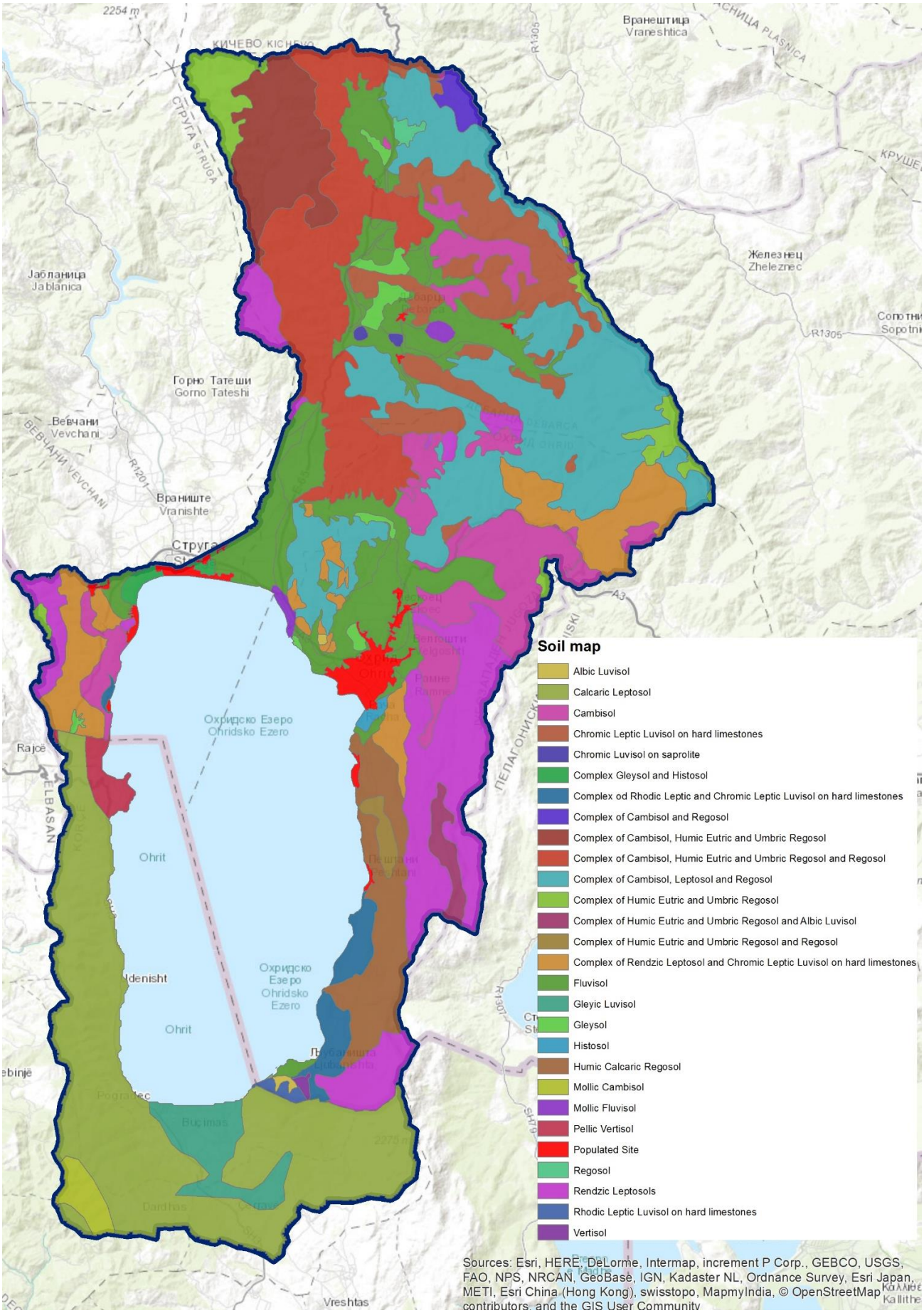
Map 1: Hydrology of LOW



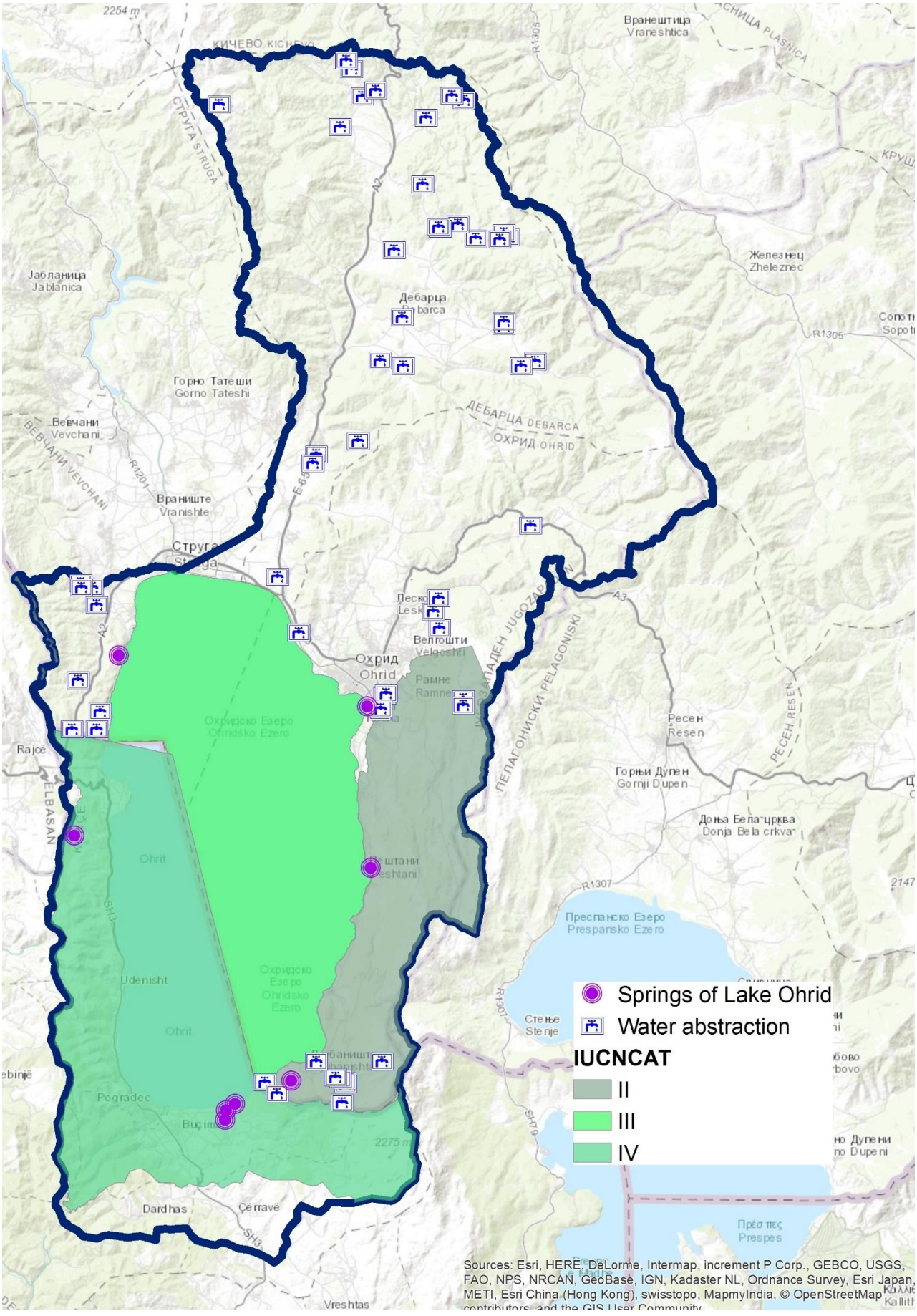
Map 2: LOW – Land Cover



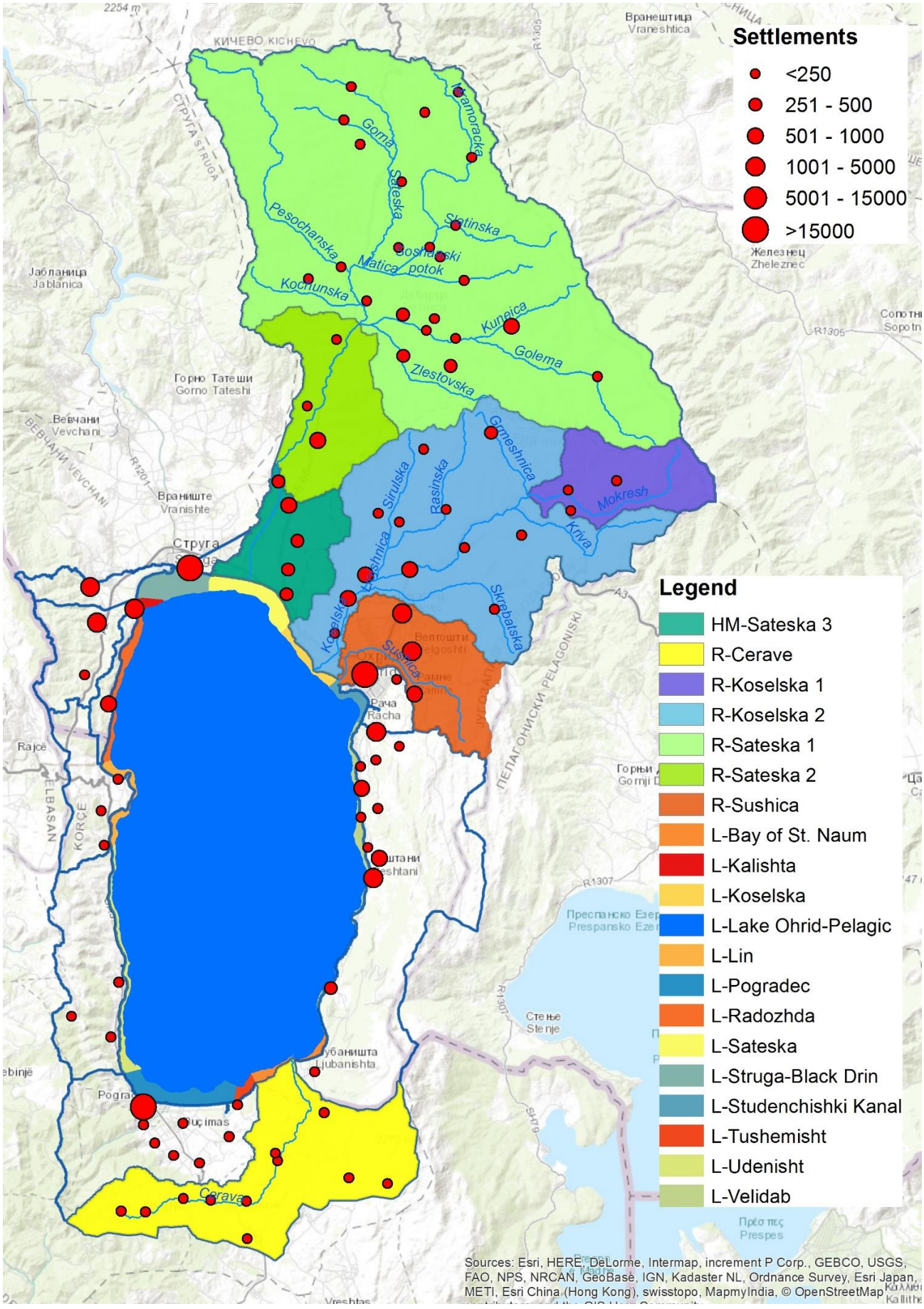
Map 3: LOW – Soil Map



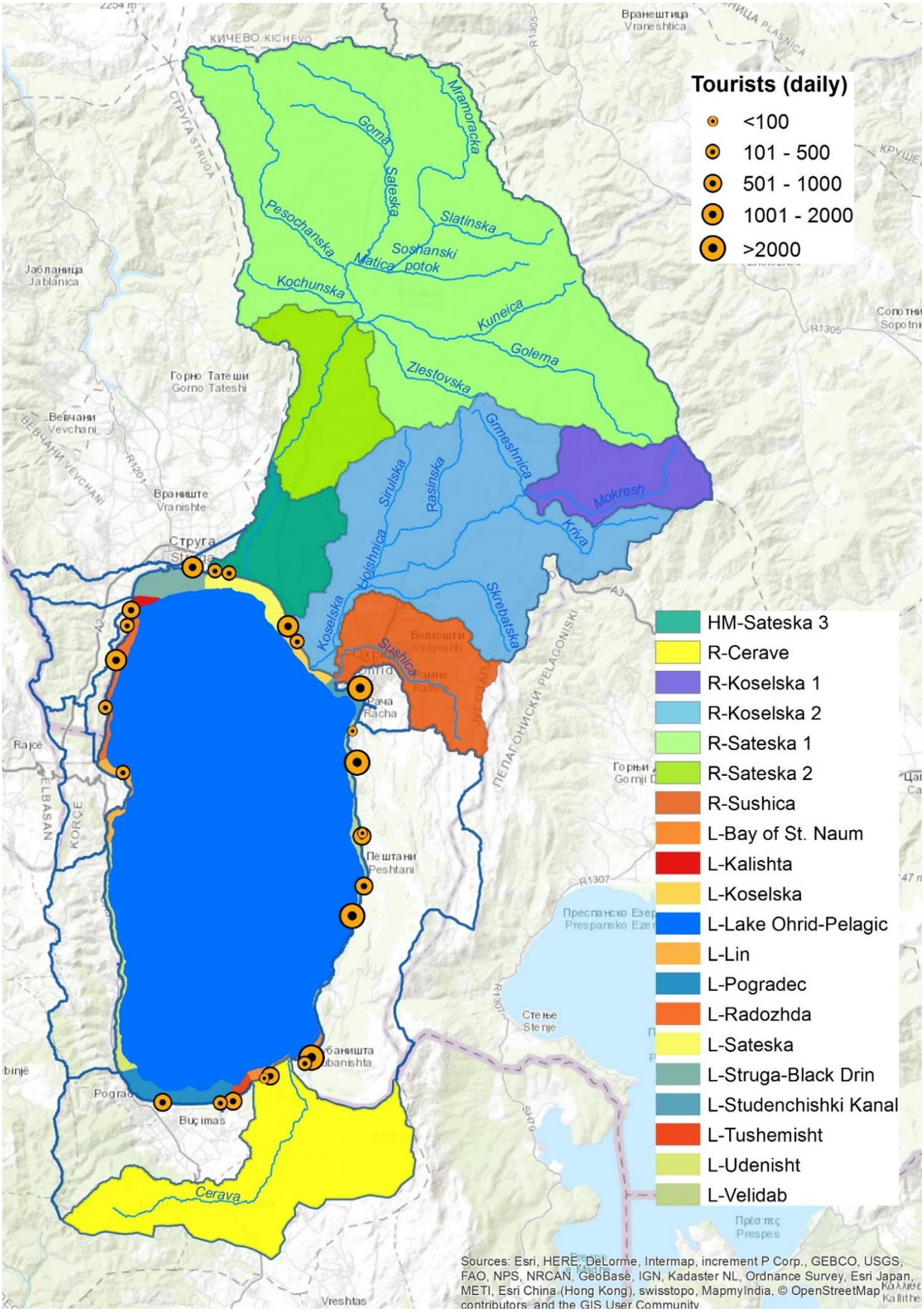
Map 4: LOW – Protected Areas



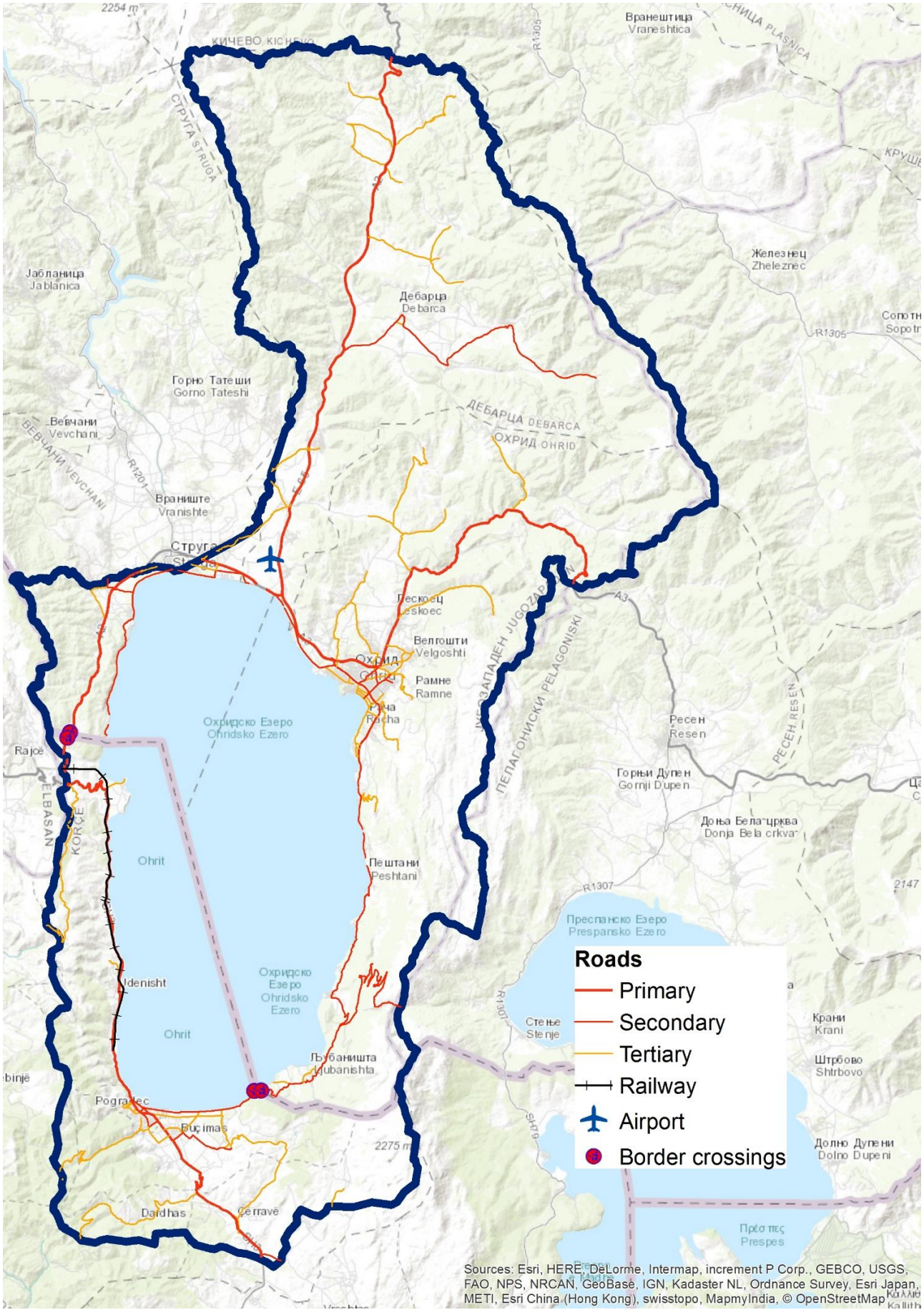
Map 5: LOW – Settlements



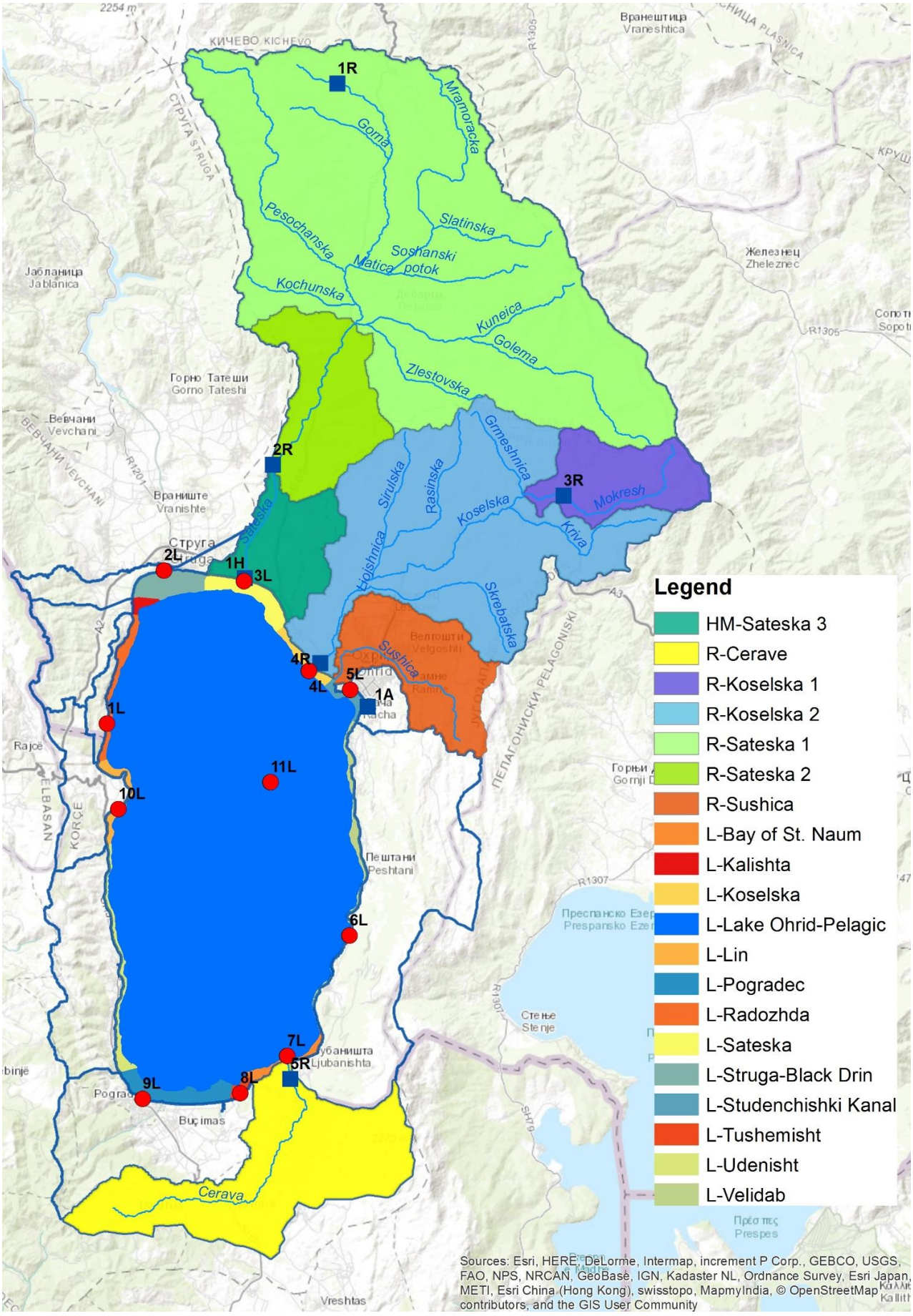
Map 6: LOW – Tourism sites



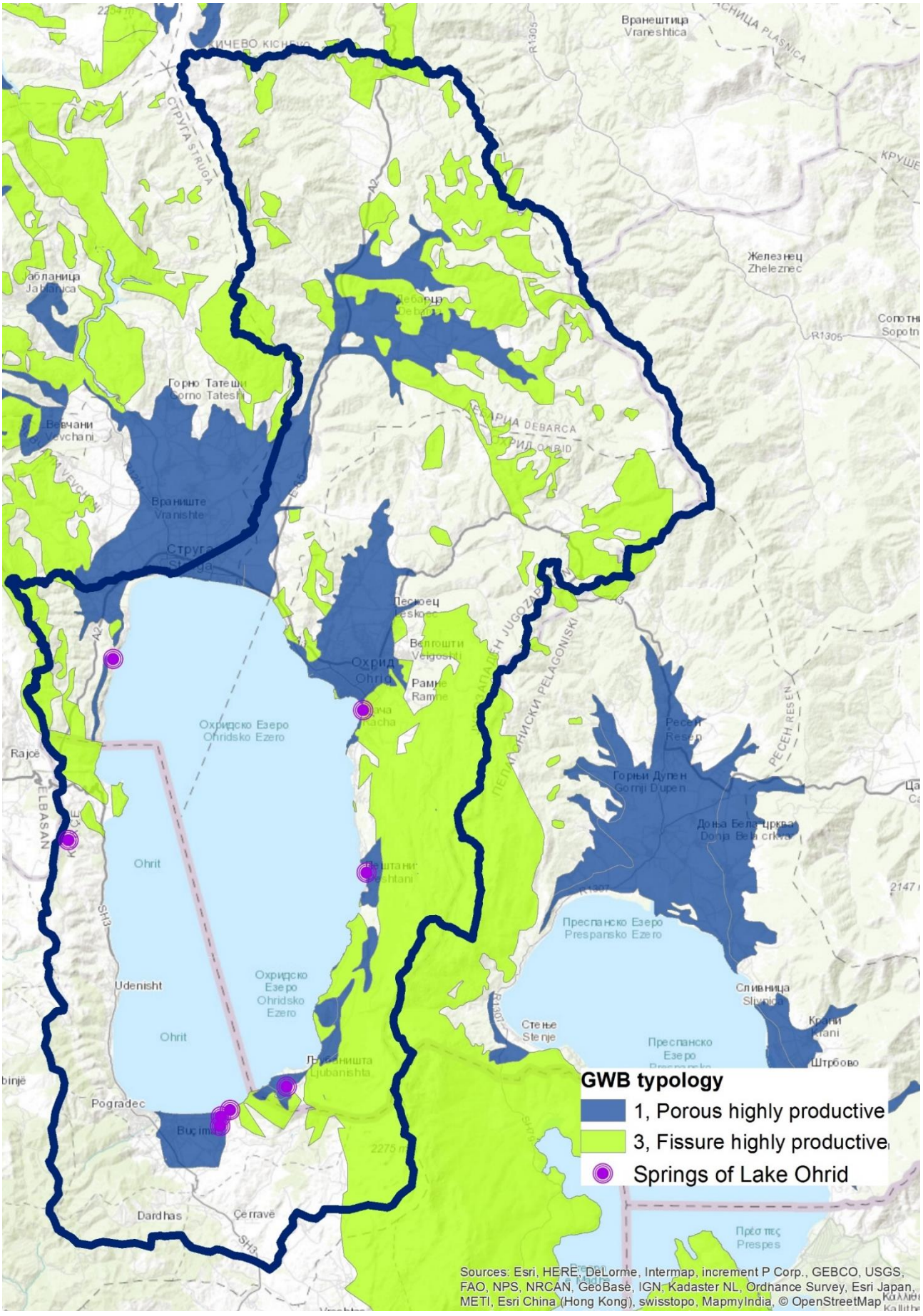
Map 7: LOW – Infrastructure



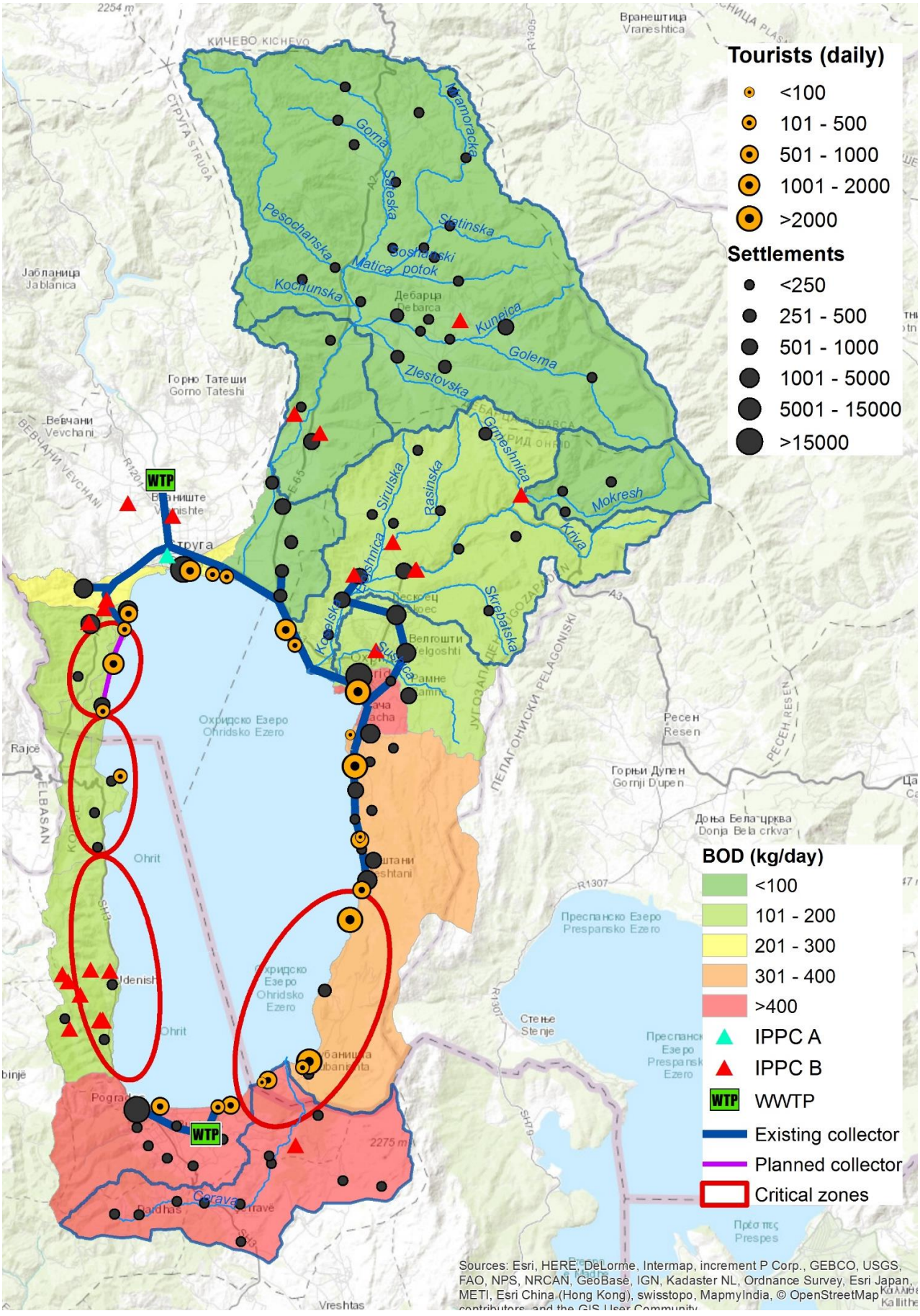
Map 8: LOW – Surface Water Bodies



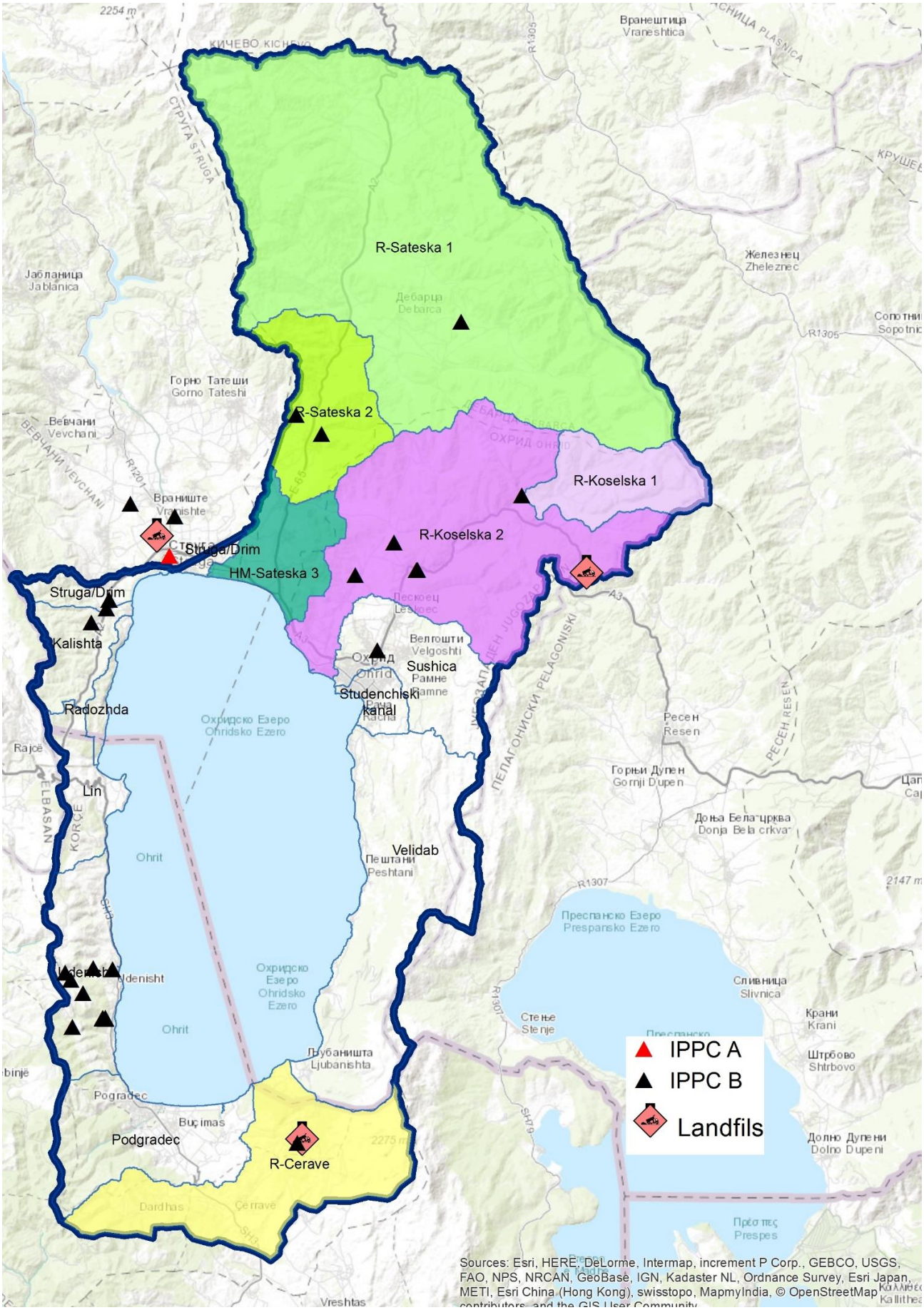
Map 9: LOW – Groundwater Bodies



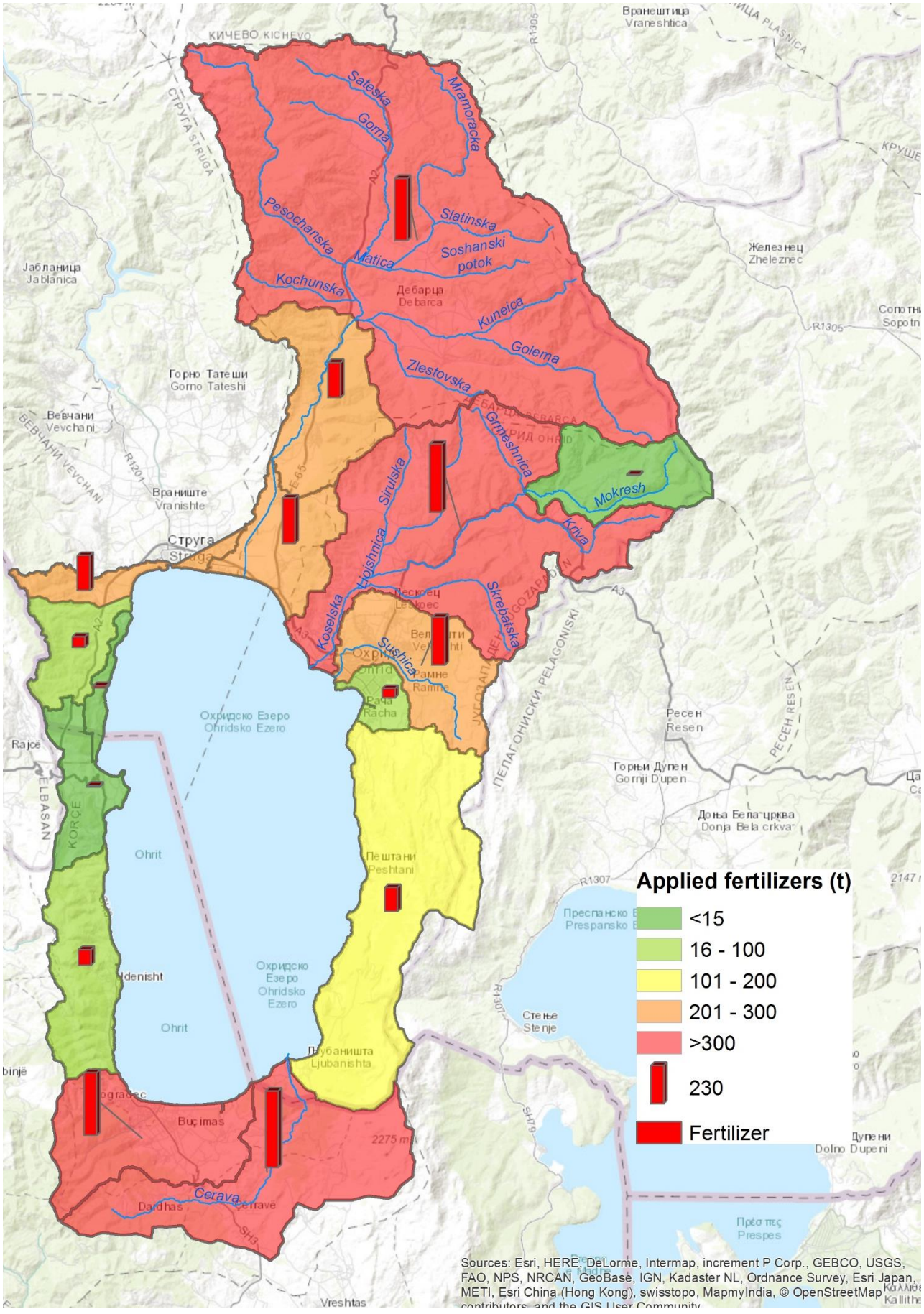
Map 10: LOW – WWM and BOD Load



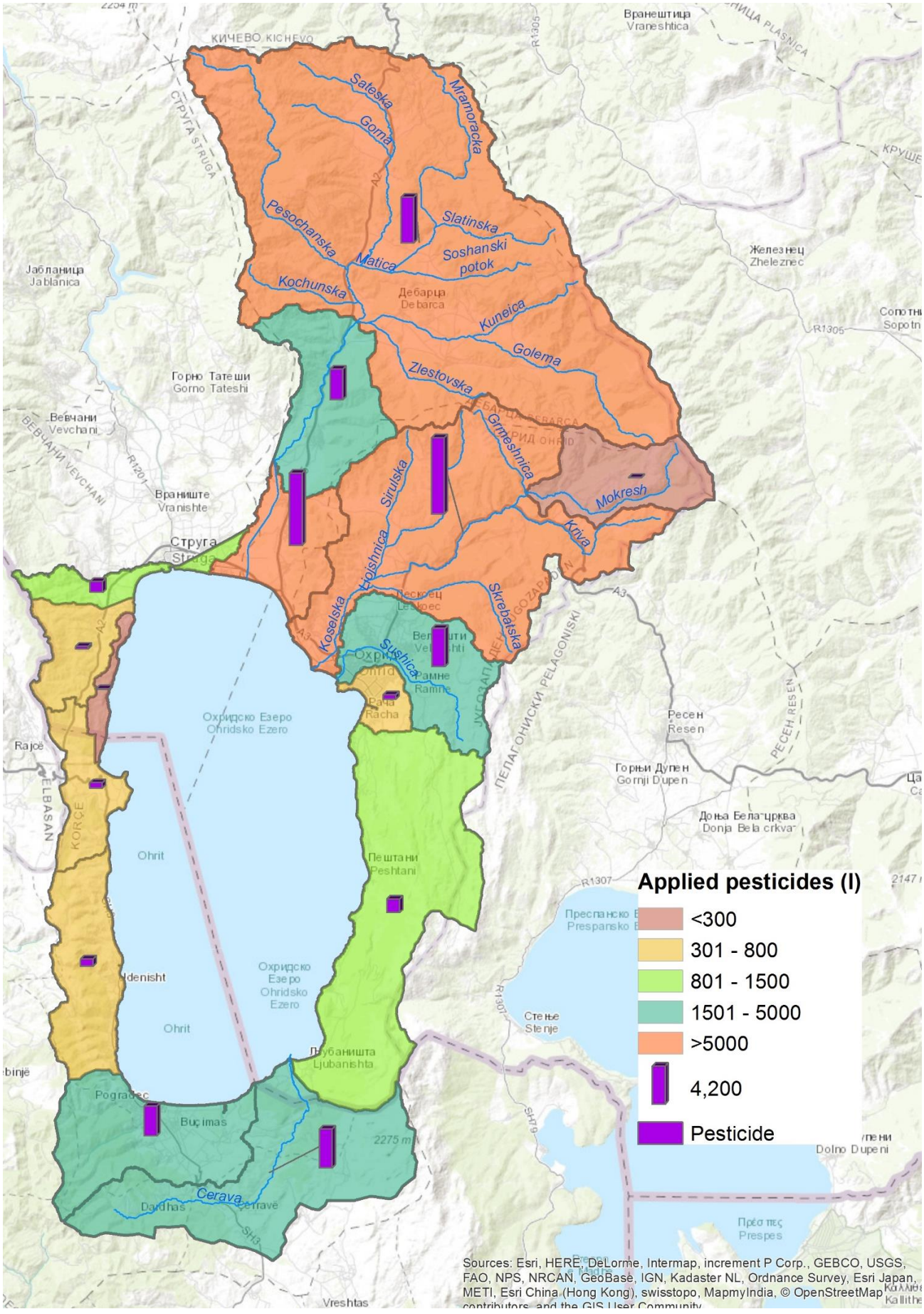
Map 11: LOW – Industry/IPPC and Landfills



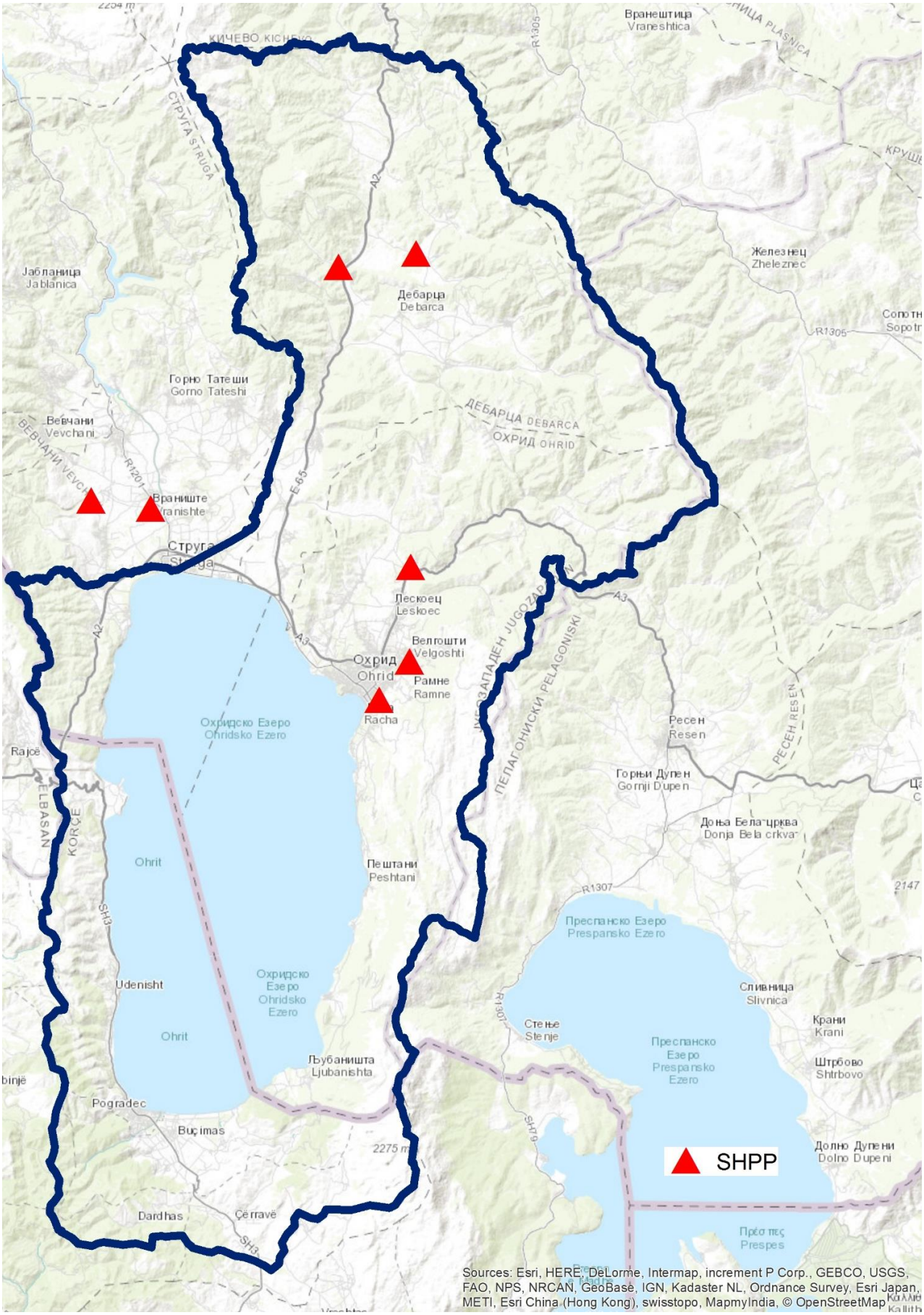
Map 12: LOW – Fertilizer use



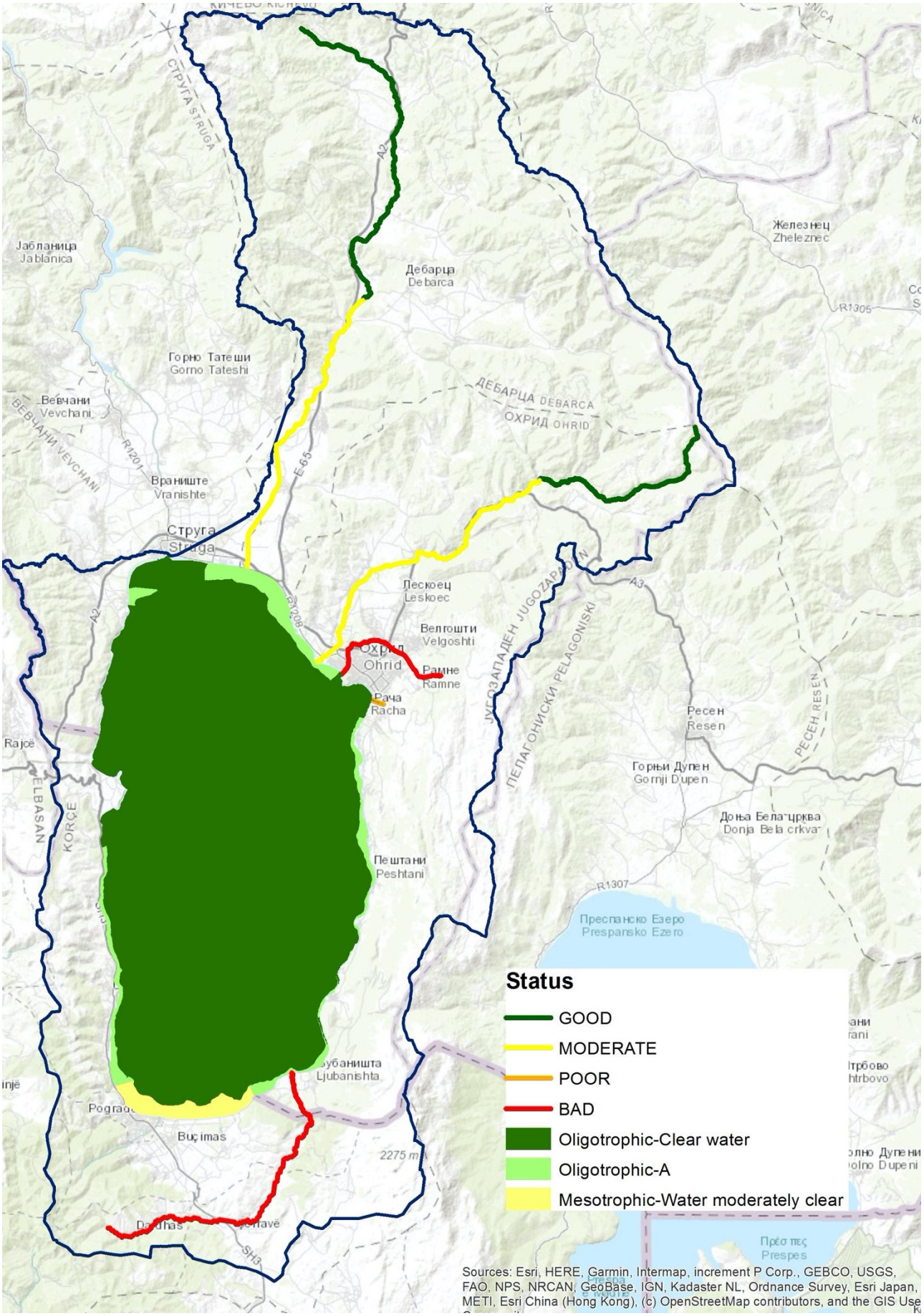
Map 13: LOW – Pesticide use



Map 14: LOW – Small Hydro Power Plants



Map 15: LOW – Ecologocal Status/Potential of Surface Water Bodies



Supplements

Doc. No. P0006769-1-H6 Rev. 0 - November 2020

Supplement I

Institutional and Legal Settings for Water Resource and Environmental Management in Albania and North North Macedonia

December 2019

Contents

1. Legal and Regulatory Framework in Albania

1.1 National legislation for integrated water management

The legal framework for management of the water resources in Albania is composed of the norms contained (in hierarchical order), in the Constitution (Kushtetuta) and International agreements, Laws (Ligjet), Decrees (Dekret), Normative acts (Aktet normative), Decisions of Council of Ministers (DCM), Instructions (Udhezimet), Regulations (Rregulloret), and Orders (Urdherat).
The basic national **Law No. 111/2012 on the integrated management of water resources amended and supplemented by Law No. 6/2018.** This is a basic, framework law directly applicable to all water management aspects. This law is implemented by regulations. These include:

- Regulation No 221 date 26.4.2018 on the organization and functioning of the Water Resources Management Agency,
- Regulation 268 date 6.4.2016 approving the Regulation on the Functioning of the National Water Council,
- Regulation No. 524 date 20.7.2016 on the organization and functioning of the Technical Secretariat of National Water Council,
- Regulation No. 342 date 4.5.2016 approving the territorial and hydrographical borders of the water basins in the Republic of Albania and the headquarters and composition of their councils,
- Regulation no. 177 dated 26.3.2014 "On the Creation, Composition, Functioning, Responsibilities and Duties of the Special Commission for the Administration of Transboundary Water",
- Decision No. 264 establishing the drainage boards in the areas of Tirane-Kavaje, Korce-Pogradec and Vlore-Sarande,
- Regulation No. 682 proclaiming the river Buna and the surrounding legatine territories as protected landscapes,
- Decision No. 684 proclaiming the Shkodra lake areas as a Managed Natural Reserve,
- Regulation No. 147 on safety of dams and barrages,
- Regulation No. 379 date 25.5.2016 approving the regulation on the quality of drinking water,
- Regulation no. 246 of 30.4.2014 "On the Determination of the Environmental Quality Standards for Surface Waters",
- Regulation no. 416 dated 13.5.2015 "On the approval of the General and Special Conditions, Accompanying Documents, Validity Periods, Application Forms for Authorization and Permit, Procedures for Reviewing and Decision-making and Authorization Forms and Permits for Water Resources Usage ",
- Regulation No. 289 on the issue of licenses, authorizations and concessions for water use,
- Regulation No. 177 on the discharge of liquid wastes and the criteria for zoning water environments,
- Guideline No. 3 on the management of potable water,
- Regulation No. 441 on the immediate suspension sand and gravel exploitation in river beds,
- Decision No. 400 approving the licensing procedures for potable water supply services,
- Decision No. 479 on the liberalization of the potable water tariffs,
- Decision No. 203 establishing potable water charges,
- Decision no. 5 dated 16.2.2016 "On the approval of the Regulation" On the Organization and Functioning of the Water Basin Council ",
- Decision no. 6 dated 16.2.2016 "On the approval of the Regulation" On the Functioning of the Water Basin Agency ",
- Regulation no. 268 dated 6.4.2016 "On the approval of the Regulation" On the Functioning of the National Water Council ",

- Regulation no. 662 dated 21.09.2016 "On the Approval of Tariffs for Water and Water discharges",
- Regulation no. 876 dated 14.12.2016 "On the Approval of Administrative Expenditures Fees".

Law No. 111/2012, on integrated management of water resources[1] provides protection of water sources, distribution and efficient administration of water, and defines the institutional framework for administration and management of waters, for community benefits and the socioeconomically interest of the country. This Law fully harmonizes the EU WFD 2000/60/EC. It focuses on:

- Environmental protection and improvement of water, surface water, either temporary or permanent, internal sea waters, territorial waters, exclusive economic zones, continental shelf, trans boundary waters, groundwater, and their status;
- Security, protection, development and rational utilization of water resources;
- Equitable distribution of water resources, by using goals and direction their effective administration;
- protection of water resources from pollution, overuse and consumption on actual needs;
- determination of the institutional framework, at national and local level, for the implementation of a national policy for the administration and management of water resources for the good of the community and social and economic interests of the country

The law prescribes integrated management and comprehensive protection of all surface and ground water bodies in accordance with natural geographic and hydrographic units instead of administrative or political boundaries. The basic instruments for water management are the National Water Resource Management Strategy and the River basin management plans. The National Water Management Strategy and the Basin Management Plan include:

- the environmental objectives;
- chemical and ecological parameters for surface water;
- chemical and quantitative parameters for the status of groundwater;
- conditions for the announcement of highly modified water bodies;
- technical specifications and standardized methods, related to the monitoring program;
- technical specifications for the analysis of water basin characteristics;
- the content of the program of measures;
- appropriate conditions and measures for flood risk management planning; and
- any other matter relevant to the implementation of the water basin management plan.

Shortly each river basin management plan contains an analysis of the basin characteristics, an analysis of the pressures and impact of human activities on environment and an economic analysis of water use; register the protection zones. The planning process is a 6 year cycle constantly repeating.
The Law differentiates between general and special uses of water. The right to exercise the special use of waters shall be acquired by the water permit. Special use of waters may be realized on the ground of concession and exercised in compliance with the agreement governing the concession. The requirements related to the use of the waters shall be issued following the procedure for preparation of the technical documentation for construction of new facilities having a permanent or a temporary impact on the water regime, or which may threaten the environmental objectives of the resource/water body.

The law refers to Law on Environmental protection of 2011 regarding the Environmental quality standards for water resources, technical norms of discharge of hazardous substances, substances and other parameters into the water environment as well as to environmental permitting procedures for water extraction. The law also defines the right to receive and use information on water resources. Every natural and legal person has the right to access/provision

[1] Fully complies with EU Directive 2000/60/EC of the European Parliament and of the Council dated 23 October 2000, Establishment of a framework for Community actions in the field of water policy

of available information on water resources. The public is entitled to information on the basic documents and data used for drafting basin management plans, as well as the opportunity to participate in the consultation and commentary process of water basin management plans.

Regarding the administrative arrangements, the National Water Council (NWC) is a central decision-making authority and it determines the national policy over water resources. The National Water Council (NWC) which is foreseen by the relevant law, is the main central decision–making institution directed by the Prime Minister, which has the responsibility to approve water national strategy and national plan for water resources. It is responsible for providing and implementing the legal, policy and strategic framework in the water sector, and for screening and reviewing the technical content of EIA, which is required for all projects that could have a significant impact on the environment, and for issuing environmental consents and permits for larger activities. The Prime Minister chairs the National Council of Water. NWC has its Technical Secretariat as its executive authority. The Ministries being responsible for the management of water resources in the respective sectors are: Ministry of Environment, Ministry of Agriculture, Rural Development and Water Administration, Ministry of Energy, Ministry of Transport and Infrastructure, Ministry of Health. The Ministry of environment in cooperation with the sector ministries develops and implements policies, strategies, programs and projects aimed at the integrated management of water resources, quantitative and qualitative preservation, and their further consolidation. Being under the authority of these institutions, a number of agencies and institutions, which are using, exploiting and monitoring the various water resources, are operating.

At local level, six river basins authorities, covering the entire territorial country divided into six river basins, are operating. The Water Basin Council is the body responsible for the integrated management of water resources in the relevant basin at the local level. The Water Basin Council has public legal status and is subject to the Technical Secretariat of the National Water Council. Further envisages water basin agency as a subordinated structure of the ministry, which is set up and operates in every water basin. In 2018 there are wide reforms on the institutional arrangements amending the Law on integrated management of water resources.

The Law No. 6/2018 amends and supplements Law No. 111/2012 regarding to the institutional framework of the water resources management as well as the tasks and responsibilities of the institutions including those of the Council of Ministers and the Agency of the Water Resources Management. The provisions on Management of Water Resources, Pollution Control, Usage of Water Resources, and Authorizations, Permits, and Concessions are also amended. [2]

According to the amendments the Council of Ministers, upon preliminary approval of the National Water Council, approves the National Strategy of Water Resources Management; it is also competent to appoint a special commission for cross-border water management. The CoM determines the territorial boundaries of each basin waters of the Republic of Albania, as well approves the hydrographic boundaries of basins water. It is competent body for approval of the river basin management plans.

According to the amendments, the water Resource Management Agency is the central body responsible for integrated management of water resources. The Integrated management of water resources at basin level is performed through the water basin councils; as well as the water basin management offices, which are Agency branches. The Council of Ministers, upon the proposal of Prime Minister approves the composition and regulation of operation of the National Water Council; and the manner of organization and functioning of the Water Resources Management Agency. The Water Resource Management Agency is a state level authority, a legal entity funded from the state budget. AMBU is organized at central and river basin level through river basin management offices. The Agency for Water Resources Management has the following competencies:

[2] For further information please see chapter2 on institutional arrangements

- develops and implements policies, strategies, plans, programs and projects that aim integrated water resource management, quantitative and qualitative storage as well their further consolidation;
- enforce the provisions of the agreements and international conventions on water resources and transboundary ones, where Republic of Albania is an party;
- carries out the functions of the Technical Secretariat of the National Water Council;
- proposes to the National Water Council issuing of concession of water resources; issuing permits and authorizations for use of water and discharges when activity is performed outside the boundary of a basin only;
- develops a national inventory of resources;
- monitors the implementation of the plans for management of river basins; as well as plans management for transboundary waters;
- is responsible for the economic funds of water resources;
- requires the bodies and institutions state agencies, agencies and public entities information, technical data, analysis or technical and consultative support they serve for management and management needs of water resources;
- encourages the participation of water users in management and management of water resources;
- promote research and development research technical feeds related to the use, detection, exploitation, storage, handling, protection, administration and efficient use of water resources; in cooperation with the institutions scientific-research, defines the fields of research and study on water resources, as well and relevant funds;
- coordinates and controls the work of local water resource management bodies;

Further, there is water management legislation directly applicable to certain aspect of the water management. Those include:

Law No. 9103, dated 10 July 2003, On the protection of transboundary lakes[3] It aims at the environmental protection of transboundary lakes in their natural state, by providing the appropriate conditions (through promoting useful activities in compliance with the requirements of the sustainable development principle) for the development of life and ecosystems in these lakes, and also stopping activities that may threaten them. In addition, unique ecosystems with international values, as the Transboundary lakes, had been proclaimed as protected areas by Decision of Council of Ministers. The Law is specifically applicable to the: a) The Albanian part of Shkodra Lake; b) The Albanian part of Ohrid Lake; c) The Albanian part of Prespa lakes. The Law defines the prohibited actions in the transboundary lakes and in their watersheds, the environmental permit for activities on these lakes, and the tariffs for obtaining the environmental permit and other relevant licenses.
The Law also provides an inventory of species and their habitats in the transboundary waters and watersheds, to protect them from danger of extinction. The Law also includes sanctions in case of violations of its provisions

Law No. 8905 dated 6 June 2002, on protection of the marine environment from pollution and damage[4]. The law aims to protect the marine environment of the country from pollution and damages and to prevent and avoid possible impacts that can be caused by the human activities in coastal and sea areas, which have a negative impact on water quality, damage water sources, endanger the fauna and flora, threaten human health, by making more difficult the normal development of activities in this environment. The Law contains a water permit, which is the permission required for using water according to the following seven main purposes:

- by means of permanent installations;
- irrigation;
- livestock
- aquaculture

[3] Amended by Law No. 35/2013 For changes and additions on the Law No. 9103, dated 10 July 2003
[4] The Law No. 8905, dated 06.06.2002, on "Protection of Marine Environment from Pollution and Damage" Amended by Law No. 30/2013, dated 14 February 2014, For changes and additions on the Law No. 8905 dated 6 June 2002

- industrial use of water
- use of groundwater for different purposes, including domesticremoval of solid material from banks and beds of rivers, streams and reservoirs, with or without water.

The Law provides for the use of water for public purposes, including potable water supply and hydropower generation, on the basis of a concession issued by the National Water Council (NWC). Water use permits are issued by the River Basin Councils (RBCs) and are issued for a period not exceeding 5 years, except for permits on water users' associations, which are issued for not longer than 10 years.

Law No. 8102, dated 28 March 1996, On regulatory framework for water supply, removal and treatment of waste waters[5] • It specifies the establishment of a regulatory framework and an independent regulatory entity for water supply and removal or treatment of polluted waters. It also provides the functions, competences, procedures and standards under which the Regulatory Entity will operate.

Law No. 9115, dated 27 April 2003, On environmental treatment of polluted waters[6] • This Law provides for the treatment of polluted industrial and urban waters. The Law establishes a separate license system on requirements, terms and conditions for construction sites of plants, and installations for water purification operations. The purpose of this Law is to protect the environment and human health from the negative impact of polluted waters, by setting rules for environmental treatment of such waters and defining binding obligations upon subjects who discharge polluted waters into the environment. The is a specific legal act that states the need for treatment of polluted water before it is discharged into the sea, preventing in this way pollution of transitional waters. The law has provisions on polluted urban waters, polluted industrial waters, according to specific industries; waters resulting from irrigation of the land; and polluted waters of any kind. The law and terminologies used in the law are in line with the legal international documents (different international Conventions) and EU Directives.

Regarding implementation of this this Law, the Council of Ministers approved **Decision of the Council of Ministers (DCM) No. 177, dated 31 March 2005, on permitted norms for liquid discharges and criteria for environmental zoning of rivers or sea waters**, which defines measurable and controlled discharges coming from the water treatment plant. DCM no.177 aims to prevent, decrease and avoid rivers and sea waters pollution caused by hazardous wastes. The DCM defined measurable and controlled discharges coming from the water treatment plant, in line with EU norms, representing a useful contribution to the national legal framework regarding water protection. In this regard, another important element to practical application of this decision was the fact that it defines criteria for environmental zoning of waters (river and sea), divining them into sensitive and less sensitive waters, followed by special discharging regulations and norms for each case.

[5] Amended by Law No. 9915, dated 12 May 2008, For changes and additions on the Law No. 8102, dated 28 March 1996.
[6] Amended by Law No. 34/2013 dated 14 February 2013, For changes and additions on the Law No. 9115 dated 27 April 2013.

1.2 Laws relevant to environmental and water management information and transparency

As the Albanian constitution of 1998 guarantees the right of access to information, the legislation for supporting this is Law no. 119/2014 "On the right to information" (Ligji no. 119/2014 "Për të drejtën e informimit"). The law regulates the right of access to information being produced or held by public sector. The rules contained in this law are designated to ensure the public access to information, in the framework of assuming the rights and freedoms of the individual in practice, as well as establishing views on the state and society situation. This law aims also at encouraging integrity, transparency and accountability of the public sector bodies. Every person shall, where deemed that the rights provided for in this law have been violated, be entitled to file a complaint administratively to the Information and Data Protection Commissioner's Office.

The law provides greater access for the public to official documents, and sets forth a system of penalties for public officials who refused to disclose information. The law also establishes the obligation to appoint coordinators for access to information by every public authority charged with the task of supervising the authority's responses to information requests and created the institution of a Commissioner for the Right to Information and Protection of Personal Data charged with supervising and monitoring compliance with the law and appeals bodies and procedures in cases of refusal or partial disclosure, The Commissioner has the discretion to use disciplinary sanctions against those violating the requirements established in the law The sanction system for failure to respect the right to information has been strengthened with the introduction of heavy administrative sanctions for officials violating the law. The law has broadened the scope of the definition of the term "public information" defined as any data registered in any form and format, maintained by a public authority as well as the definition of the term "public authority" which now encompasses commercial companies where the state hold the majority of shares, as well as any legal entity exercising public functions. Proactivity of publication for certain categories of information has been introduced. The law establishes that requests for information of public interest can be made orally or in writing. The provision of information is free of charge: the law only enables public bodies to charge the costs for photocopying; no charge can be applied to electronic delivery. Public bodies are obliged to give an answer within 10 days from the submission of the request. In case the request is rejected, the applicant has the right to appeal to the Commissioner and then to the courts.[Exceptions to the right to information are established by the law, including for reasons of national security and international and intergovernmental relations.

The main articles from specific laws regarding the access to the environmental information are listed below:

- The Albanian Constitution defines the right of information as a fundamental human right Art. 23 & Art. 56 (specifically for environmental information);
- Law No. 10431, 09/06/2011, "On protection of the Environment", Art.13 & Art. 47 – "without having or showing a specific interest";
- Law 10448, 14/07/2011, "On Environmental Permits", Art. 23, public SIM – System of Environmental Information;
- Law No. 119/2014, "On the right of information"; Art. 3, "without having to explain motives"; and "within 10 working days", or maximum "15 working days;
- Law No. 152/2013, "Civil Service", Art. 44, "the obligation for transparency and confidentiality";
- DCM No.16, dated 4.1.2012 "The right of public to have access on environmental information".

The Law on integrated water resource management regulates in Article 91 the right to receive and use information on water resources. According to its provisions each natural and legal person has the right to defeat the provision of available information on water resources. The public is provided with information on the basic documents and data used for drafting basin management plans, as well as the opportunity to participate in the consultation and commentary process of water basin management plans. No further details on the manner and procedure for implementation of this right are in place.

Albania has also committed itself to realize the right to access public information through several international agreements. In 2002, Albania ratified the **Convention on access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (The Aarhus Convention)** which requires the adoption of

laws on access to environmental information. Moreover, as a member of the Council of Europe, Albania has committed to comply with a 2002 recommendation on access to official document.

1.3. Other applicable environmental legislation relevant for certain aspects of water management

As the water resources are part of the brother concept of environmental management, the following legislation should be also taken into consideration integrated water management:

Law No. 10431, dated 9 June 2011, On Environmental Protection[7]. This Law provides a water quality standard to prevent, control and reduce pollution in the water. It elevates the obligation for environmental protection to a higher level from the laws related to this field that were enacted between 1993 and 2002. The law specifies protection and improvement of environment and quality of life, and provisions for Albania's sustainable development. The Law refers to issues such as water resource protection, water quality norms and standards, and air and soil protection. It also deals with the goals and principles of EIA, the relationship of EIA to technical designs, and establishes the National Environmental Agency (NEA) as the competent authority in relation to environmental permits. The Law also underlines the obligation of any state or private entity to invite public and other interested parties to participate in activities related to environmental protection. The Law provides the principles of "polluter pays" and of "recovery of the costs". Article 48 of the Law contains provisions on access to justice, and guarantees individuals and organizations the right to bring cases to court when there has been damage, pollution or a threat to the environment. The public has the right to ask the relevant public authorities to take appropriate measures within the prescribed deadlines, and a lawsuit may be filed in court against a public authority or any natural legal person causing damage to the environment. Criminal penalties for breaches of environmental law are defined in the Penal Code of the Republic of Albania[8]. The Law on Environmental Protection (2011) is a framework law. It has been approved and entered into force in 2012. Its objective was to raise the level of environment protection by establishing a consolidated network of environmental institutions at national and regional level linked with environmental policy implementation. During the period 2013 to 2014 the legislation concerning the Rules and Procedures on Environmental Impact Assessment (EIA) and Environmental Permissions (EP) together with the relevant regulatory package have been drafted and approved. It deals with the principle "the Polluter Pays" and establishes the legal basis and procedures regarding environmental damage accountability.

Law No. 91/2013 "On Strategic Environmental Assessment" and all related by laws constitute the minimum requirement for the SEA assignment. The legislation requires that plans and programmes that might have significant environmental impacts are subject to a SEA. Since the implementation of the RBMPs might have significant Environmental impacts, it is required the RBMPs should be supplemented by a Strategic Environmental Assessment (SEA) in order meet the requirements of the Albania Law No. 91/2013 "On Strategic Environmental Assessment" and of the Helsinki1 and Espoo2 Conventions that relate to the management of transboundary waters, which Albania has signed and ratified.

The Law on Environmental Impact Assessment (2011) aims to transpose the respective EU Directive on the assessment of the effects of certain public and private projects on the environment. The Law provides the context and sets the basic principles of the EIA process nevertheless; it doesn't define neither the procedures nor the rules and responsibilities for the evaluation of significant adverse impacts of private or public projects on the environment. The EIA procedure is carried out in accordance with the provisions of Law no. 10440, dated 7.7.2011, "On Environmental impact assessment" and the relevant by-laws issued on the basis of the EIAA. The national legislation does not foresee merger of the AA and EIA procedures. All the private or public projects which are likely to have significant effects on

[7] Amended by Law No. 31/2013 "For changes and additions on the Law No. 10431, dated 9.6.2011 "On Environmental Protection""which fully complies with Directive 2004/35/KE of the European Parliament and Council dated 21 April 2004 on "Environmental Liability, Prevention and Rehabilitation of Damage on Environment"

[8] Law No. 7895 dated 27 January 1995, The Penal Code of the Republic of Albania, details Crimes against the environment.

the environment must undergo the set EIA procedure before issuance of the relevant development consent (Articles 3 and 7 of the AL EIA). Who will be the EIA competent authority depends on the competences for issuance the development permissions under Law.no107/2014 "On the territory planning". This Law regulates the impact assessment procedure for projects that may have significant effects on the environment, the contents of the Environmental Impact Assessment (EIA) Study, the participation of authorities and concerned organizations, the public participation, transboundary exchange of information for projects that may have significant impact on the environment of another state, supervision and other issues of relevance to impact assessment. The Law provides that the EIA procedures will be further detailed through Decisions of Council of Ministers9 and/or methodologies/guidelines.

Law No. 9663, dated 18 December 2006, On Concessions This regulates procedures for granting concessions for use of natural resources, including water resources used for hydropower production, distribution and management, and for the collection, distribution and management of water for irrigation, drainage and cleaning of canals and dams.

Law No. 9587, dated 20 July 2006, On the protection of biodiversity The Law defines the protection of biological diversity. It regulates the sustainable use of its elements through integration of the main elements of biodiversity in strategies, plans and programmes, and at all levels of decision-making. The Law includes aquatic and marine areas, and the diversity of living organisms in these areas, by implementing a National Strategy Plan (to be adopted every 10 years) and the Action Plan for biodiversity. It establishes an inventory and monitoring networks, and penalties for unexpected harm to the environment that can form a threat to biodiversity.

The Law on the Integrated Management of Waste (2011) is part of legislation covering waste management. While the Law on Environmental Protection sets the aim of waste management, this law provides specific requirements with regard to the management of different waste categories including specific criteria for their storage. There are foreseen environmental standards and procedures for:

- waste collection,
- transportation,
- Treatment and disposal.

The law transposes the Waste Directive (2008/98/EC); for this reason a number of by-laws (on landfilling, incineration etc.) have to be follow and apply.

As regards the protection of biodiversity, the main piece of legislation is the **Law on Biodiversity Protection (2006) that together with the Law on Protected Areas (2008)** covers the majority of issues regarding nature protection and conservation. This Law regulates the nature protection by protecting the biological and landscape diversity, and the protection of the natural heritage, in protected areas and outside of protected areas. Law on protected areas provides for management, and ensures sustainable use of protected areas and their natural and biological resources. The Law establishes six categories of protected areas (including marine and coastal zones) and their definition. According to this, the management of water in a protected area shall be the responsibility of the administration in charge of the area. The administration of such activities shall be exercised directly or through an authorized subject. In cases when these properties are in private ownership they shall be managed and utilized by the owner and legal user, providing that this management is in compliance with area management plans approved by the Ministry of Environment.
There are other legal acts that deal with specific species of flora and fauna. The adoption of the **Law on the Protection of Wild Fauna (2008)** improved the approximation of the legislative framework to the Wild Birds Directive. The Decision Concerning the Declaration of Nature's Monuments as Protected Zones (2002) complements the law on Protected Areas; there are 750 nature and geological monuments described in this Decision.

[9] (DCM No. 13, date 14.01.2013 "on Rules, Responsibilities and Timeframe for the Development Procedure of EIA").

A new **Law on Hunting** was adopted in 2010, amended in 2013, aiming to regulate the hunting system in Albania. The aim of the Law is "to ensure the sustainable management of wildlife populations and their habitats in the manner and to the extent that permanently maintains and enhances the vitality of wildlife population, productive capacity of habitats and biodiversity, and thereby achieving the fulfilment of economic, ecological and social functions of hunting". According to the Law, everybody who has a hunting licence can hunt, while seasons of hunting depend on species. It should be noted that private owners cannot lease their right to hunt. Law on "announcing a moratorium on hunting in the Republic of Albania (2016) has foreseen the strict criteria and procedures, deadlines, seasons and relevant area for hunting activities in Albania.

Law on Forests and Forestry Service (2005) governs the administration, protection, and use of forests. This Law states the conditions for sustainable management of forests and forest lands as goods of public interest, in a manner and to an extent which conserves and enhances their productivity, biological diversity, ability to regenerate and vitality, and increases their potential for the mitigation of climate change and their economic, ecologic and social functions, without inflicting damage to the surrounding ecosystems. There are some other sublegal acts which have specified forest fees, guidelines, and instructions for protection against fires, and the rules on using the forests for recreational purposes.

1.4. National policies and strategies for integrated water management

The **National Strategy for water resources integrated management 2018-2027** was adopted and approved with regulation No. 73. The national strategy of integrated management of water resources 2018-2027 has five strategic objectives including the sustainable use of water resources, the attainment of good water quality in all water resources by the year 2027, disaster risk reduction and management for drought and floods, increase of sound scientific knowledge on water and climate issues, and application of inclusive and sustainable water management practices that yield equitable profits to all involved stakeholders.

The strategy presents a detailed situational analysis including the challenges the sector faces as well as the policies of addressing these challenges. To this end, the efforts will be focused on the improvement and expansion of water supply, orientation of water services towards principles of cost control and recuperation, improvement of administration institutional frameworks, investing to increase sector capacity, and full approximation of domestic legislation with the EU water legislation. Specifically, the action plans will address the rehabilitation and modernization of water supply infrastructure, review of tariff-related legal issues including their differentiation, provision of financial assistance to specific categories of consumers, cost recuperation for the service providers, and assets evaluation for the water supply systems. To make agriculture more productive efforts in the irrigation sector will focus on water protection and quality protection through plans of water management, continuous monitoring of surface water quality, rehabilitation and modernization of irrigation systems and expansion of irrigation zones for the production of the high quality crops, recuperation of up to 90% of maintenance and management costs, increase of total capacity in water gathering etc.

The Agency of Water Resources Management is the main institution responsible for the implementation of this strategy and building synergies with other line ministries. Reporting, monitoring and assessment will be done using the Matrix of Performance Evaluation that will be prepared by the Agency and will employ indicators selected among those used for the National Strategy for Development and Integration 2015-2020.

The National Strategy of "Water Supply and Sewerage" was adopted in 2011 by the decision of the Council of Ministers No. 643, dated 14 September 2011. It improves the provision of water supply and sewerage services, and moves towards convergence of Albanian Law with EU Water Directive:

- It increases: (i) access of both urban and rural populations to safe, reliable drinking water (ii) the connection of both urban and rural populations to sewage collection networks.

- It orients water utilities towards principles of cost control and full cost recovery: (i) targets investments into reducing non-revenue water and energy consumption (ii) requires to all licensed water utilities to have a fully documented asset management system and to develop an annually updated 5-year business plan
- It improves governance and regulation in the sector: (i) strengthens the role and functions of the Water Regulatory Authority (ii) expands the licensing activities of the Water Regulatory Authority (iii) develops a Model Service Delivery Agreement (iv) strengthens the new General Directorate in its role as Technical Secretariat under National Water Council and River Basin Agencies
- It invests in enhancing the capacities of the sector workforce: (i) establishes a national programme of training and certification, with training target requirements at all water utilities (ii) requires all Supervisory Council members of licensed water utilities to attend and complete a training course on their roles, duties and responsibilities

National Strategy for Development and Integration 2014- 2020:

- is to ensure good management of basin catchment and integrated management of transboundary waters: (i) fully transposes EU acquis in the area of water resource management into national legislation (ii) adopts joint agreements with the Republic of Kosovo, Montenegro, North Macedonia and Greece on improving management of transboundary waters (iii) is to rehabilitate riverbeds by 25% by 2020 compared to 2011, and reduce permits for river exploitation
- is to develop the sector and establish a data collection system for marine inhabitants: (i) to establish an effective data collection system on fishing fleets and on the biological conditions of Albanian waters (ii) to build Durres fishing port and fish wholesale markets
- is to expand and improve the quality of the water and sewerage services sector to ensure: (i) urban water supply network coverage at 100%, and in rural areas at 95% (ii) sewerage network coverage in urban areas at 89% and in rural areas at 60% (iii) that the percentage of the population connected to a wastewater treatment service is increased to 50% (iv) continuity of water supply service to 22 hours a day throughout the country (v) that utilities are orientated towards full cost recovery and control through full recovery of maintenance and operation costs with revenue from all utilities (vi) that non-revenue water is reduced to 30% by 2020.

2. Integrated water management institutional Framework in Albania

2.1 Overview

Albania is a parliamentary democracy based on the principle of three branches: legislative, executive and judicial. The highest legislative authority in Albania is the Assembly of Albania (Kuvendi i Shqipërisë or, in short, Kuvendi or Parlamenti). The executive branch of the government is represented by the President (Presidenti), the Prime Minister (Kryeministri) and the Council of Ministers (Keshilli i Ministrave). In addition to the central authorities, Albania also has local self-government units (local authorities)[10]. There are 61 municipalities (Bashkia) and 12 counties (Qarku)[11].

The local authorities exercise certain rights, such as the right of governance, property, etc.[12]The local authorities exercise limited rights in respect of nature protection. According to the Law the local self-government units are competent for regulation and performance of affairs of public interest of local relevance, specified by law. The Law also specifies the list of exclusive competences of the local self-government units, including environment and nature protection, protection from impacts for noises and unionized radiation, sewerage and treatment of public waste water, and collection, transport and treatment of municipal solid waste and technological waste.

2.2 Water management governance – Central and local level authorities

According to the Article 7 of the Law on integrated water resource management, the National bodies of water management and management may be central level management authorities and local bodies for integrated water management.
The Central Management Bodies and water resource management are:

- The Council of ministers;
- National Water Council; and the
- Water Resource Management Agency.

As mentioned above the law No. 6/2018 amending the Law on integrated water resource management introduced major amendments to the institutional setup for integrated water resource management in Albania.
In a nutshell, the Water Resource Management Agency is established to replace the previous Technical secretariat of the National water council as a central governmental body responsible for water management resulting in that the ministries no longer competent to develops and implements policies, strategies, programs and projects aimed at the integrated management of water resources, quantitative and qualitative preservation, and their further consolidation.

The Agency is responsible for policies oriented towards the efficient and sustainable development of water resources, in order to increase the economic and quality of life of present and future generations.
The mission of the Agency is the good governance of water resources in order to meet all vital needs, keeping in mind the sustainability of ecosystems, promoting the competitiveness of uses and advantages towards economic profitability. The Agency has responsibilities and duties for integrated water management.
The reform is aimed to overcome the main gaps in applying IWRM principles emerging form the high fragmentation of institutions involved in water resources management and clear definition of the responsibilities of all cross-sectorial involved institutions.

The Local bodies for integrated management of water resources are:

- the water basin councils; and
- water basin management offices, which are the Agency branches.

[10] Law no. 115, dated 31 July 2014, 'On administrative-territorial division of local government units in the Republic of Albania' ('O.G.' No. 137/2014).
[11] Article 108/1 of the Constitution of Albania ('O.G.', No. 28/ 1998).
[12] Law no. 8652, dated 31 July 2000 'On the organization and functioning of local government' ('O.G.', No. 25/2000), amended by Law no. 30/2015 ('OG', No. 51/2015).

2.3. Central level authorities - Executive competences

The Council of Ministers, is the main regulatory and policy decision making authority. Upon the proposal of Prime Minister approves the composition and regulation of operation of the National Water Council; and the manner of organization and functioning of the Water Resources Management Agency.
The Council of Ministers, upon approval preliminary to the National Water Council, with Prime Minister's proposal:

- approves the National Strategy of Water Resources Management;
- appoints a special commission for cross-border water management;
- determines the territorial boundaries of each basin waters of the Republic of Albania, as well the center of council composition of each of them;
- approves the hydrographic boundaries of basins water;
- approves the river basin management plans;
- determines areas, distances and width of the shores of water resources

The Council of Ministers, upon the proposal of The Prime Minister, after the preliminary approval by The National Water Council approves the requirements for content, development and implementation of the National Management Strategy Water Resourcesas well as of the plans basin management. The Council of Ministers, upon the proposal of The Prime Minister, after the preliminary approval by The National Water Council classifies the waters, approves the criteria for setting environmental objectives

The National Water Council is the central decision-making body responsible for managing water resources. The National Water Council is an inter-ministerial body chaired by the Prime Minister and addresses issues of integrated management and management of water resources. The powers of the National Water Council are:

- approves interregional and national plans and projects in the field of agriculture, urban planning, industrial and territorial development, when related to water conservation and management;
- takes appropriate measures for the implementation of any international agreement, water management conventions of which the Republic of Albania is a party;
- issues permits and authorizations for water use and discharges when the activity is performed outside the boundary of a single basin;
- approves the initiatives of any contracting authority for initiating concession procedure for the use of water resources and upon the conclusion of the concession contract, the concessionaire is licensed to use the water source, if signed by the Chairman of the National Water Council. In case these water resources are of national importance, as defined by the Council of Ministers, the concession agreement enters into force after ratification by the Assembly;
- approves the regulation of the river basin councils Council, the water basin council and the water basin agency. The acts of the National water council of a normative nature are published in the Official Journal

The national water council is responsible in case of heavily modified water bodies to:

- declare certain bodies of water as artificially or highly modified when environmental objectives with regard to their good status or their good ecological potential cannot be attained due to technical impossibility or very high costs;
- extend the deadlines for achieving environmental objectives, provided that no further deterioration in the status of the affected aquatic body occurs;
- to establish specific environmental objectives for certain bodies of water when they are highly affected by human activity or where their natural conditions are such as to achieve the achievement of unavoidable or costly overall environmental objectives.

The National council defines appropriate measures to prevent the deteriorating body status that has been declared as an overly modified water body

National Committee on High Dams The National Committee on High Dams is under the responsibility of the Council of Ministers. Its functions and responsibilities are provided for in Law No. 8681, dated 2 November 2000, On Design, Construction, Use and Maintenance of Dams and Tailings.28 The National Committee on High Dams exercises state control on the safety of dams as work of special importance, in the review, design, construction, exploitation and maintenance stages. The National Secretariat on High Dams acts as the executive body of the Committee, while the National Inspectorate on High Dams acts as the body that exercises control over the construction, use and maintenance of dams.

Inter-institutional Maritime Operational Centre (IMOC) IMOC is an inter-ministry, national institution that guarantees the sovereignty and sovereign rights of the Albanian state in the maritime space though an integrated management of national sources of the institutions that are responsible and have interests on the sea. It guarantees the management and control of Albanian maritime borders, life safety on the sea and interaction of state institutions that have responsibilities and interests within the maritime space. The participating institutions in the IMOC are the Ministry of Interior; Ministry of Defence; Ministry of Finance; Ministry of Environment; Ministry of Transport and Infrastructure; Ministry of Agriculture, Rural Development and Water Resources; and the Ministry of Economic Development, Tourism, Trade and Entrepreneurship. IMOC coordinates and leads coastal operations for the control of the maritime border against illegal trafficking and organized crime, anti-pollution operations, operations to protect fishing, to preserve the ecological equilibrium and maritime environment, and operations for the protection and good administration of fishing wealth (an etiological bio-measurement).

Water Resources Management Agency is a state legal entity that is fundedfrom the state budget. The Agency is is organized at central level and at river basin level through river basin management offices. The Agency for Water Resources Management has the following competencies:

- develops and implements policies, strategies, plans, programs and projects that aim integrated water resource management, quantitative and qualitative storage as well their further consolidation;
- enforce the provisions of the agreements and international conventions on water resources and transboundary ones, the pair of which is also Republic of Albania;
- carries out the functions of the Technical Secretariat of the National Water Council;
- propose to the National Water Council concession of water resources;
- proposes to the National Water Council issuing permits and authorizations for use of water and discharges when activity is performed outside the boundary of a basin only;
- develops a national inventory of resources waterways, both quantitatively and in terms quality;
- designs and follows the implementation of the plans management of water basins;
- compiles and follows the implementation of the plans management for transboundary waters;
- is responsible for the activity economic resources of water resources;
- requires the bodies and institutions state agencies, agencies and public entities information, technical data, analysis or technical and consultative support they serve for management and management needs of water resources;
- encourages the participation of water users in management and management of water resources;
- promote research and development research technical feeds related to the use, detection, exploitation, storage, handling, protection, administration and efficient use of water resources;
- in cooperation with the institutions scientific-research, defines the fields of research and study on water resources, as well and relevant funds for them;
- coordinates and controls the work of local resource management bodies;

The Agency has the responsibility to supervise the drafting of the National water resource management strategy by the bodies, entities and specialized water bodies. The Agency is obliged to cooperate with the sector ministries for issues which are an inherent competent of other bodies (such as drinking water safety, environmental permitting, nitrate/phosphates pollution etc.)

The Agency in cooperation with the sector authority identifies the hygienic-sanitary areas for the protection of water resources, designated for the production of drinking water; nature protected areas, areas for fishing and growing of

shellfish, areas for thermal baths, curative treatment and recreation; eutrophication areas and areas at risk of nitrite and nitrites; target areas for the protection of plants or animals, as well as habitats, where maintaining or improving the status of water is an important element of their protection.

The Agency is also responsible and carries out the cross-border water management, based on management plans for transboundary waters, approved by the Council of Ministers. The plans contain identification of the duties of various state bodies, study institutions, environmental organizations for the management and protection of transboundary waters. However, a Special Commissions for the Management of Transboundary Waters may be established.

The Agency in cooperation with the respective ministries, organizes the work for the protection of transboundary waters, controls the implementation of the requirements for integrated water management and participates in:

- the design and implementation of transboundary water management plans;
- design and implementation of special monitoring programs;
- design and implementation of plans for the rehabilitation of contaminated and damaged transboundary waters ;
- creation of a contemporary legal framework for the management and protection of transboundary waters;
- the provision and efficient use of the necessary financial means;
- supervises to ensure the preservation of the natural state of fauna and flora of transboundary waters.

The Agency establishes, maintains, manages and updates the National Register for all permits, authorizations and concessions issued by water management and water management bodies.
The Council of Ministers, may define additional competencies for the Agency upon proposal of the prime minister.

The River Basin Council is the body responsible for the integrated management of water resources in the relevant basin at the local level. The Water Basin Council has the following tasks:

- Provides the conservation and rational development of water resources within the boundaries of the relevant water basin;
- ensure the proper distribution of water resources within the boundary of the relevant water basin, according to the purposes of their use and their effective management and management;
- Provides protection of water resources from pollution, abuse and damage affecting their quality and quantity;
- Identify relevant water bodies that need protection.

The council is competent to issue authorizations and permits when the activity is to be carried out within the territory of the Republic of Albania and within the boundaries of a single basin

The offices for river basin management are a subordinate structure of the Water Resources Management Agency, which is set up and operates in every water basin. The offices for water basin management have the following tasks:

- drafts the water resource plan for the respective basin and submits it for approval to the river basin council;
- draws inventory of water resources in quantity and quality, and periodically updates it;
- Promotes the participation of water users in the management and management of water resources;
- prepare reports, give feedback on water resources and submit them for further follow-up to the river basin council;
- prepare materials for the meetings of the river basin council.
- follow the implementation of the decisions of the National Water Council and the river basin Council.

The river basin basins offices in cooperation with regional environmental agencies, prepare programs for preventing and avoiding contamination of receiving water resources under their jurisdiction from liquid discharge.

The offices compile the program of measures for the water basin, taking into account the results of the analysis of the RBD characteristics. The National Water Council, with the proposal of the relevant basin council, approves the program measures drafted by the Office.
The basin offices keep a register listing all licenses, authorizations, permits and concessions issued in accordance with this Law and bylaws for its implementation.

Special Commissions for the Management of Transboundary Waters
For the protection and management of transboundary waters special commissions may be established. The composition, functions, responsibilities and duties are regulated by special legal and sub-legal acts. Upon the proposal of the Prime Minister, after the preliminary approval of National Water Council, the Council of Ministers appoints a special commission tasked with the administration of transboundary waters, managing the relations with the border countries for these waters, based on Albanian legislation and relevant international agreements.

Water Regulatory Authority (WRA) is a public and independent regulatory authority, responsible for regulating the sector of water supply and wastewater disposal and treatment in Albania. WRA has been established and functions based on law no.8102, dated 28.03.1996, on the "Regulatory framework of the sector of water supply and wastewater disposal and treatment", as amended. The WRA's mission is to ensure for all consumers in Albania, that water supply and sewerage service providers deliver the highest achievable quality at a fair price and in a financially sustainable manner. Water Regulatory Authority is headed by a five member National Regulatory Commission. The objectives of WRA are the following: Encouraging efficiency and efficient use of water, urging and supporting protection of environment and quality of water, protecting the consumer interests regarding tariffs and service conditions, quality, efficiency and continuity of the service for all consumers, guarantee the rights of complaint and standards of service, transparent activity and finding a fair balance between all actors in this sector, consumers, Government and the investors.

WRA is accountable to the Parliament and to the Council of Ministers of the Republic of Albania. Each year by January 31, WRA releases its annual report on the activity of Water Regulatory Authority and the situation in the water supply and sewerage sector. WRA's financial audit is carried out by the Supreme State Audit Office of Albania. The Commission holds the following competencies: a) issues licenses for commercial entities engaged in providing water supply service to the benefit of the population; b) approves water sale prices and tariffs, both wholesale and retail, tariffs for wastewater and its treatment, schedules and conditions for the service offered by the operators, who provide water for public consumption. This also applies in cases where the water supply and sewage systems have been transferred to the administration or ownership of local government units; c) sets standards for investment programmes and asset sale from the licensees in the water supply and sewage sector. This also applies in cases where water supply and sewage systems have been transferred to the administration or ownership of local government units; d) establishes and guarantees the implementation of work standards for the licensee; e) encourages uniform standards and rules for the entire sector; f) prepares reports on the status of the sector for the Council of Ministers and collects relevant information from the licensees; g) sets applicable tariffs for licenses; h) issues administrative and monetary sanctions; i) issues rules that support the execution of the competencies and functions laid down in this Law; j) exercises any other function deriving from the above-mentioned functions.

2.4. Certain aspects of the water management in the respective sectors

Ministries are being responsible for certain aspects of the water management in the respective sectors.

Ministry of Tourism and Environment is responsible for drafting and implementing policies, strategies and national plans related to climate change, for the protection of aquatic resources, water resources, inland and temporary water surface, marine water and groundwater. Under the supervision of MoE are:

- The National Environmental Agency which has as its main duties to monitor the state of the environment and to monitor the quality and quantity of water resources and to develop new policies for their protection and improvement. National Environmental Agency monitors wastewater discharges.
- Regional Environmental Agencies responsible for permitting and enforcing environmental legislation
- The State Inspectorate of Environment, Forests and Water, which ensures the enforcement of legislation on environmental protection, forests, water and fishery.

The Ministry of Agriculture and Rural Development is responsible for water utilization for irrigation purposes and drainage. This ministry is responsible for water utilization for irrigation, for drainage, for the protection of flood systems and for the preservation of fishery resources. At regional level, the Ministry performs this duty through its regional Directorate of Agriculture and through drainage boards (DBs):

- drainage boards are technical, specialized structures, responsible for operation and maintenance of drainage, flood protection systems and main irrigation infrastructure (large dams and main irrigation canals)
- The Fishery and Aquaculture Sector, within the Directorate of Water and Fishery Policies, has a range of responsibilities for the drafting of policies, strategies for fishery and aquaculture development and the preparing of the Fishery and Aquaculture Administration Plan. This sector is also responsible for directing and coordinating the monitoring and controlling system for scientific research projects that relate to sea fishery resources, the evaluation of internal waters, and fishery information and statistics systems.

Ministry of transport and infrastructure responsible for the elaboration of the policies related to water supply and sanitation. The authority is in charge of developing policies on water supply and sewerage systems, and for investing in waste management facilities. Through its General Maritime Directorate, it is responsible for maritime transportation of passengers and goods, monitoring of maritime traffic and hydrograph/surveillance, sea ports, and monitoring the protection of the sea environment and sea resources (fishing, gas/oil, tourism). Within the Ministry, the **General Directorate of Water Supply and Sewerage** has a special status. Its structure is approved by the Council of Ministers and while it reports to the Ministry, it is not formally part of the structure of that Ministry. The Directorate is in charge of water supply canalization problems and sewerage. The General Directorate of Water Supply and Wastewater (GDWW) is a public institution under the Ministry specialized in water infrastructure; it has been established by the Council of Ministers with the main responsibility to develop the strategic framework and to provide technical support in the water supply and sanitation. General Directorate of Water Supply and Sewerage GDWSS is a public institution established by the Council of Ministers Decision No. 532, dated 20 August 1996, On Structural Changes and Staff Nomination. It is a legal, individual and budgetary unit under the Ministry of Transport and Infrastructure, and is the only specialized public institution in the water infrastructure sector. The capacities that the Directorate provides are: to assure technical support to the water and wastewater policies of the Ministry of Transport and Infrastructure; to plan and manage the identification of new projects related to the water sector; to organize and administer the work of investment procurement (studies, designing, rehabilitation, new construction) in accordance with the legislation in force (only in cases defined as procurement entities); to draw up a strategic framework of water and wastewater sector development and management; to prepare legal norms related to water supply administration and water sewerage; to draw up an annual planning platform of water infrastructure public investment.

Ministry of Health is responsible for setting drinking water standards and monitoring the quality of drinking water, bathing water and curative waters, by protecting water sources and the chlorination of supply entering the distribution systems. Through its **Institute for Public Health**, it is responsible for monitoring the safety of water supply, including water chemical and biological monitoring. It is responsible for setting drinking water quality standards and monitoring drinking and bathing water quality. Ministry of Health, in cooperation with the Management Agency Water Resources, designs quality requirements for drinking water. The Council of Ministers, upon the proposal of Minister responsible for health, adopts quality requirements for drinking water. The Minister in charge of health, in cooperation with the central institution responsible for the water supply of the population, through the inspectorate covering the area of health, orders termination of supply drinking water if it does not meet quality standards. This process is implemented under the overall management of the Water Resources Management Agency, as part of the cycle of integrated water resource management. The State Sanitation Inspectorate is authorized to monitor the quality of drinking water. The Institute of Public Health performs biological monitoring.

Ministry of Energy and Industry is responsible for responsible for hydropower production and power produced by renewable energy resources. The country currently relies on hydropower for almost all of its electricity, which creates difficulties when water flows are low. Through its National Agency of Natural Resources it implements government policies in the area of hydropower and energy, promotes renewable energy sources, supervises any mining when hydropower activities are involved, monitors concessionary contracts for hydropower plants, and compiles and publishes the annual energy balance sheet at national and regional level.

Ministry of Interior This Ministry implements tasks and competencies in the area of water resources management. Through the General Directorate of Civil Emergency, the Ministry monitors, manages and controls states of emergency, including floods and other emergencies, in the entire territory of Albania.

Ministry of Economic Development, Tourism, Trade and Entrepreneurship Within this ministry, the tourism sector is responsible for the planning and approval of tourism policies, and has the duty to ensure and protect the sustainable use of water resources for tourists.
Monitoring of waters is carried out by scientific institutes contracted on annual basis. Those include:

The **Institute of Geoscience, Energy, Water and Environment** (IGEWE) is in charge to monitor surface water quality and quantity. It is a part of the Polytechnic University of Tirana and is under the Ministry of Education and Sports (MES), and does not report directly to the Council of Ministers. IGEWE is responsible for surface hydrological and meteorological monitoring as well as for issuing a daily meteorological bulletin. Institute of Geological Science Energy, Water and Environment (GSEWE) is a national research unit comprising seven main departments and operating under the supervision of the Polytechnic University of Tirana. The institution is responsible for studying and evaluating the country's natural mineral and underground energy and water resources; for groundwater quality and quantity monitoring; for assessing surface water quality for rivers, lakes, underground and marine water; and for monitoring rainfall, temperature and other hydro meteorological parameters.

The **Albanian Geological Survey** is responsible for groundwater quality and quantity monitoring. It also conducts the watershed hydro-geological studies and recommends measures for the protection of groundwater resources. Albanian Geological Survey (AGS) The AGS operates under the supervision of the Ministry of Energy and Industry. Its department for natural resources, hydrogeology and water assessment focuses on sustainable management of natural resources; monitoring the natural phenomena of erosion and exploitation of minerals in relation to water quality; and modelling and development of digital data in order to set up a Geographic Information System (GIS). Its main activities encompass the stability of riverbeds; coastal erosion; sedimentation; impact assessments; preventive measures; construction of permanent monitoring; and systematic observations on secondary flows and river networks downstream, as well as sustainable aggregates management.

2.2.3. Associations of water users

The Water Supply and Sewerage Association of Albania This is a not-for-profit association of water supply and sewerage professionals formed by a group of representatives from eight water supply and sewerage enterprises in Albania, to represent the interests of the enterprises operating in the water sector, and to raise the level of professionalism. Its objectives are to improve the capacity of the people who work to deliver water supply and sewerage services, so they can perform their duties in a professional, reliable and cost-effective manner; and to represent the interests of water supply and sewerage utilities in Albania regarding laws, decrees and regulations that may be proposed for action by the Parliament or the Government.

Water User Associations (WUAs) are operating at local levels as private and financially independent entities to manage the irrigation.

Business Associations- Albanian Union of chamber of Commerce and industry. The Union of Chambers exercises its activity within the territory of the Republic of Albania and its powers extend over the entire territory covering the Chambers of Commerce and Industry of the Circuits. The Union is established to represent and promote the general interests of chambers for the development of trade and industry at all levels; to promote the relations between the chambers of the regions of the Republic of Albania and their cooperation with the equivalent bodies of other countries; to collect, process and distribute trade data at national level by creating its own trade and industry data system; to obtain continuous data from the court about the state and changes in the trade register; to organize, administer and finance exhibitions and fairs, courses and trainings at the national level, as well as any other activity in the busi-

ness interest; to provide opinions, proposals and evaluations for legal initiatives or public policies undertaken by the Government, the content of which is related to the interests of its members; to exercise other functions that may be delegated by state bodies, laws or international agreements, where the Republic of Albania is a party; to promote and deliver services of general interest to the benefit of members; to be informed, in support of the law, on the exercise of the activity of the member Chambers; and to iintermediate in resolving possible disputes between the chambers.

2.2.4. Civil Society Organizations

The Law on Non-Profit Organizations (No. 8788, dated May 7, 2001, revised) sets out rules for the establishment, functioning and activity of non-profit organizations. Aligned with this law, non-profit organizations, namely, associations (non-profit organizations with membership), foundations and centres (non-profit organizations without membership) base their activity on the principles of protection of human rights and independence from the state. There are around 12,000 CSOs— including associations, foundations, and centres — registered in the Tirana Court of First Instance. The CSOs negotiate (lobby) on matters of public interest. They address a wide range of issues and work on many different levels, including global, regional, national and local levels. Different types of CSOs include NGOs, community groups, research institutes, think tanks, advocacy groups, trade unions, and academic institutions, sections of the media and professional associations. CSOs are to be considered as one of the crucial stakeholders for the success of the river basin management planning and implementation process. They can serve as a mediator for securing active participation of citizens and creation of relation based partnership with the central but also local level authorities in which citizens play an active role and engage in the process of policy-making. This last level recognizes the important role of citizens in the validation of current policies or in proposing alternative policies and shaping the policy dialogue. The CSOs could also motivate the authorities to shift towards proactive practices of dissemination of information to citizens on their own initiative. Last but not least, the CSOs are best positioned to facilitate the consultations as a two-way relation in which citizens' role consists of providing feedback to the authorities, usually in the form of input data, policy-making proposals and evaluation of policy implementation. Creation of relation based partnership of the CSOs with the authorities in which citizens play an active role and engage in the process of policy-making is one of the anticipated multiplier effects.

2.2. 5. Competences in sharing public information

Apart of the Water Resource management Agency **competences in sharing public information**, other authorities are also responsible to provide information that may be relevant for the River basin management planning, implementation of the plans and River basin management in whole. Under the structure of the Ministry of environment, the specific Sector of Communication Transparency within the Directorate of Legislation and Communication Transparency is responsible for collecting monitoring data with aim to make all of it available to the public. Public bodies and legal entities are obliged to publish related information. Public authorities are obliged to collect and must make their environmental information available on a proactively way towards the third party. Ministry competent for the environment is responsible to deal with significant environmental issues: collection the data and statistics with national character for forests, biodiversity, water resources, environmental permits, for protected area, for programs of Inspections, for environmental strategies and plans, international agreement signed, as well as the projects to be implemented on the field of environment. The national Environmental Agency (NEA) is in charge to collect, publishes and updates all the information regarding the current state of environment; report on data on the state of environment, monitoring environmental, including monitoring the quality of environmental, pollution and damages, biodiversity and emissions. National environmental Agency is responsible for preparation of registry of pollutants. MEI is in charge to collect all data and information on mining sector, mines and permits mining, on industrial areas, energy issues, Hydropower Plants etc. Ministry of Health is in charge to: to supervise the public health through collecting the data on air quality, and their consequences in public health; and to monitor the level of noises on the urban zones and their effects on public health, quality of drinking water standards and beach water quality. MARDWA is responsible to collect the data on using the pesticides on agriculture sector, which have impact in environmental, and protection of soil. MTI is in charge for polluted waters, urban Waste, projects in infrastructure which have impact on environmental (treatment waters plants, landfills of waste, plans for development of roads and infrastructures as well the data regarding the air transportation and their impacts on environment.

These stakeholder groups will affect the implementation of the Project and are potential beneficiaries of the outputs resulting from its implementation. They are structurally related in accordance with their respective missions and responsibilities and the manner in which they can engage in the process of implementation of the River basin management and transparency.

3. Legal and regulatory framework in North North Macedonia

3.1. National legislation for integrated water management

There is an extensive body of law in the areas of water management as well as environment and natural resources management.

Law on waters (Consolidated version Official Journal no. 87/2008, 6/2009, 161/2009, 83/2010, 51/2011, 44/2012, 23/2013, 163/2013, 180/2014, 124/2015, 146/2015, 52/2016) forms the basis of the regulatory framework. The Law on Waters (2008) is transposing the EU WFD and daughter directives provide a good basis for further progress in the field of water management. It is a framework law13 regulating issues concerning both surface and underground waters and defining management and control of water use, protection and prevention of water contamination, protection against floods, as well as financing of water management activities. The adopted bylaws regulate among others: the conditions under which deviations from aquatic environment quality targets will be allowed; specific conditions for direct and indirect discharging of wastewaters; identification of water bodies with water intended for human consumption etc. This law determines the conditions and the manner of use, protection and control of pollution of the waters, as well protection against adverse effects of waters (management in cases of droughts, erosion, flooding). There are number of subsidiary legislation adopted in the field of water management:

Classification of water
Surface water classification Decree 99/2016
Decree on categorization of watercourses, lakes, reservoirs and groundwater (18/99 of 09/31/1999 Year)
River basin
Ordinance on content and methodology for preparation of RBMP (OG 148/09)
Ordinance on methodology for assessment of river basins (OG 148/09)
Decision on river basins delineation (OG 107/12)
Ordinance for the structure, the way of membership, and also the way of nominating the representatives in the councils for managing the river basin areas and the council for managing parts of river basin areas, as well as the way of functioning (OG 106/13)
Programme of measures
Regulation on content and methodology for the preparation of program of measures (OG 148/09)
Water monitoring
Regulation on the content and manner for preparation of information and maps for water monitoring activities (OG148/09)
Advisory Bodies
Decision on the establishment of the National Council on Water (OG RM149/09 of 15.12.2009 PAGE 60, N. 3126)
Basic Design Documents
Ordinance on Methodology for the content , method and procedure , revisions of the Water Master Plan of the Republic " (148 / 09 of 14.12.2009 Year)
Ordinance on the form and content of the application for refusal to adopt a decision on the request for accepting or rejecting the watermanagement approval " Official Gazette (129/11 of 23.09.2011 Year).
Decision making in the draft amending the Master Plan of the Republic of expert discussion " (70/12 of 07.06.2012 Year)
National Water Strategy (2012 - 2042) " Official Gazette " (122/12 of 01.1.2012 Year)
Urban waste water
Ordinance on the form and content of the application and the permit reuse of treated wastewater as a way of granting consent (Official Gazette 60 of 27.04.2011)
Ordinance on the form and content of the application and the permit for use of sludge and ways of issuing the permit for use of sludge (Official Gazette 60 of 27.04.2011)
Ordinance on the form , and other written materials MANNER of data delivery and the type of information using sludge from the treatment of urban waste managed in accordance with its purpose , treatment, com-

[13] It refers to lex specialis for regulation of a particular water management issues and also provides the basis for the adoption of secondary legislation that will transpose other Directives as well.

position and place of its use (Official Gazette 60, at 27.04 .2011)
Ordinance on the methodology and procedures for sludge use, maximum concentration of heavy metals in soil in which the sludge was used, concentration of heavy metals in sludge, in accordance with its use and maximum annual quantity of heavy metals that can be deposited in soil (OG 73/11
Ordinance on detailed conditions for collection, transport and treatment, methods and conditions for design, construction and operation of systems and plants for treatment of urban wastewater, technical standards, parameters, emission standards, and norms for quality of pretreatment, removal and treatment of wastewater taking into account load and methods of treatment of urban wastewater that are to be disposed in the sensitive areas (OG 73/11
Ordinance on detailed conditions, methodology and maximum allowed concentration of parameters of treated wastewaters reuse (OG 73/11
Regulation on conditions, methods and emission limits for discharging of treated wastewater, methods of calculation taking into account special requirements related to the protected areas (OG 81/11)
Ordinance on collection, disposal and treatment, the manner and conditions for the design, construction and operation of the systems and stations for purification of urban wastewater, as well as technical standards, parameters and emission standards and norms for quality pre-treatment waste water treatment, taking into account the load and method for purification of urban wastewater that is discharged into sensitive areas of discharge of urban waste water
Ordinance on criteria for determination of sensitive areas related to the urban wastewater discharges (OG 130/11)
Wastewater discharge
Conditions of hazardous and harmful substances and their emission standards that can be discharged into the sewer or drainage system , surface or ground in water bodies and the coastal lands and wetlands (108/11 of 12.08.2011)
Regulation on conditions and how the emission limit values for discharges of waste water after purification , method of their calculation , taking into account the specific requirements for the protection of protected areas(47/11 of 08.04.2011 Year)
Submission of information
Regulation on procedures of transfer of information of disposed wastewater monitoring, and format and content of the form for information distribution (OG 108/11)
Monitoring of wastewater discharge
Regulation on methods, referent methods, parameters of wastewater monitoring, including the sludge (OG 108/11)
Inspection
Rulebook on the form and content of the invitation for education, the conduct of education, and the manner of keeping records conducted only education (118/11 of 01.09.2011 Year)
Pollutants
List of the polluting matters and substances (OG 122/11)
Water Right
The decision to start the procedure for granting a concession for water use for electricity production from hydropower plants on Black River (144/13 of 22.10.2013)
The decision to start the procedure for granting a concession for water use for electricity production from hydropower plants on the Crna River and participating in public-private partnership with ELEM "(129/12 of 10.18.2012)
Decision amending the Decision to start the procedure for granting a concession for water use for the production of electricity from hydropower plants on the Crna River and participating in public-private partnership with ELEM "(138/12 of 06.11.2012)
Water protection
Ordinance on technical and other requirements about installing and operation of plants that work with dangerous substances and test modes of the machines by experts before commissioning and at regular intervals during operation (*) (123 , of 12.09.2011)
Rules for establishing criteria for determining nitrate sensitive zones (*) " (131/11 of 28.09.2011 Year) .
Decision designating protected areas of the source " Studencica "(151, of 31.10.2011)
Rules of form and content of register of protection zones of protected areas determined as natural heritage where maintenance and improvement of the status of waters is an important factor (25 of 02.19.2013)
Assets of fees and contribute to water

Ordinance on how to transfer the information from the monitoring of wastewater discharged, and the form and content of the form for submitting data , Official Gazette no. 108/11 of 12.08.2011 Year
Ordinance on (drinking) water safety (OG 46/2008 FROM PAGE 35)
Decision for setting out the borders of protection zones of spring Rasce and determining the protection measures (No. 08-3550/1, 1990)
Book of regulations of the content and way of keeping the book on water (OG n. 4/98)
Book of regulations on calculation of the fee for the used or utilized water by the legal entities producers of electric power (OG no. 1/2000)
Book of regulations on the form and way of issuing license for the water economy inspector (OG no 4/1998)
Ordinance on the form and the way of keeping a diary for exploitation of sand, gravel and stone (OG no. 4/1998)
Book of regulations on the content and way of record keeping of the water economy structures and facilities (OG no. 4/1998)
Book of regulations on the minimum required activities and measures for technical observation of the dams
Book of regulations on reporting on the level and quantity of accumulated water in the reservoirs as well as on quantity of discharged water (8/1999)
Rulebook on space, equipment, staff with appropriate education for authorization of legal entity for preparation of Elaborate for borders of protection zones, protective measures and other conditions for water intended for human consumption, Official Gazette of the RM No.29/2014 (Page 43-44)
Rulebook for proscription of content and manner of preparation of the Elaborate for borders of protection zones, , protective measures and other conditions for water intended for human consumption, Official Gazette of the RM No.29/2014
Book of regulations on the way of observing the sediment in the reservoirs (OG no. 4/1999)
HYDROMETEREOLOGICAL INSTITUTE
'Decision on the establishment of a Commission for implementation the procedure for giving the authorization of legal entities and individuals who can perform research on the atmosphere, climate, water and soil and works on the application of meteorology and hydrology "No. 02-1569/1 from 06.02.2009
'Establishment of a Commission of Government of Republic of North North Macedonia responsible for addressing the administrative affairs of the Hydro meteorological activity'' No. 42/09 from 26.03.2009 (pg 29)
'Rulebook on the form, content and manner of keeping the register of submitted meteorological and hydrological data and products from foreign legal and natural persons " No..28/09 from 25.02.2009 (pg 107)
'Rulebook on the form, content and manner of keeping the register of foreign legal and natural persons performing meteorological and hydrological works and documentation necessary for enrollment to the registry " No 28/09 from 25.02.2009 (pg 109)
'Regulation on conditions relating to technical equipment and suitability of the premises for conducting research works on the atmosphere, climate, water and soil application of meteorology and hydrology, and the form, content and manner of keeping the register of domestic legal and individuals who perform Hydro meteorological services " No. 69/09 from 04.06.2009 (pg 10)
'Decision for determination of the amount of compensation for the Hydro meteorological with occasional observers and scorers'' " No.33/09 from 06.03.2009 (pg 3)
'Memorandum of Understanding between the Hydro meteorological Service and the Crisis Management for achieving mutual cooperation, coordination and communication about matters of Hydro meteorological activity'' *This memorandum has been prepared and signed by the Hydro meteorological Service under No. 02-176/4 from 03. 03.2009, and the Center for Crisis Management No. 02-244/7 from 27.02.2009
'Rulebook on the performance of hydrometeorology for the defense of the Republic of North Macedonia'' No.74/2009 from 15.06.2009 (pg 7)
"Rules for determining the hydrological and meteorological data and information that is classified information" No.74/2009 from 15.06.2009 (pg 7)
"Tariff for the fee of real costs incurred to perform services providing meteorological data and products from the archives of the Hydro meteorological Service" No.33/09 from 06.03.2009 (pg 7)
"Regulations on the procedure for notification and warning of natural disasters" No.96/09 from 31.07.2009 (pg 181)
"Decision authorizing the experts of the Hydro meteorological Service to perform professional supervision and execution of activities hydro meteorological activity by legal and natural persons" No 02-1570/1 from 06.02.2009
'Regulation on the observations and measurements of the qualitative characteristics of water in the net-

work of hydrological stations '' No.33/10 (pg 15)
'Rules Basics prognostic system and procedures to forecast air quality, water and soil '' No.22/10 (pg 181)
'Rules Basics prognostic system and procedures to forecast air quality, water and soil '' No.22/10 (pg 181)

Additionally there are draft subsidiary acts to be adopted:

- Decree on minimum water quality standards for achieving surface and ground waters environmental objectives as well as the manner and conditions for classifications of waters;
- Decree on classification of groundwater bodies;
- Decree on the conditions when derogation from the objectives for water environment quality is permitted; and
- Ordinance on special conditions for discharge in the groundwater, the measures and activities that are covered by the permits and which should be undertaken in order to avoid any input of any polluting material or substance in the groundwater

A number of “horizontal” issues as well as issues related to sectors associated with basin management have been regulated through a substantial amount of secondary legislation and implementing documents. The effort for the improvement of the management framework in this regard is on-going.

3.2. Laws relevant to environmental management and nature protection

The country water regulatory framework is further consisted of *lex specialis* in certain areas: **Law on drinking water supply and drainage, collection and treatment of urban wastewater** (Official Gazette 68/2004, 28/2006,103/2008, 17/2011, 54/2011) as lex specialis for water supply and drainage, collection and treatment of urban wastewater.

Law on determining the prices of the water services (2015) constitutes lex specialis and defines the principles, conditions and procedures for the establishment and implementation of the economic instrument in the area of water services. The LPWS regulates the policy objectives for the water utilities/services of: bulk water supply for drinking purposes; drinking water supply; collection, disposal and treatment of waste water, establishment of a functional system for pricing of water services; the manner, conditions and procedure for determining the prices of the water services, the structure of tariffs for water services, and the competences of Energy Regulatory Commission (ERC) in relation to the determination of the tariffs for the water services. The general objective of the law is to ensure the establishment of a financially self-sustainable system of water services, which shall provide a high standard of services at reasonable price, in line with the objectives of the National Water Strategy of the Republic of North Macedonia and the management plans for river basins.

Law on Water management (2015) regulates the management, utilization, operation and maintenance of hydrosystems and irrigation and drainage systems by the entities acting as water management activity providers Its objective are to ensure economical management, use, functioning and maintenance of the hydro systems, irrigation and drainage systems, defining the scope of services provided to users of water by the provider of the water-economy activity, establishing conditions for normal and successful operation of the provider of the water-economy activity and use of its services by the users of water and establishing a joint stock company in state ownership Water management Inc. of the Republic of North Macedonia (State owned) The Water Inc. is the legal successor of the existing Water Management enterprises, which were established under the Law on Water Management Enterprises ("Official Journal" No. 85/2003, 95/2005, 103/2008, 95/12 and 1/12). With the entry into force of this law, the existing water management enterprises continue to operate as subsidiaries bodies of the Water Inc. The Water Inc. has competences to maintain and manage irrigation and drainage systems as a whole. The scope of operation of The Water Inc. is defined in Article 5 as supply of water for irrigation; supply of water intended for human consumption to the PUCs (drinking water and other uses); supply of water for industrial and technological (economic) needs, including production of energy; regulation of river beds; land drainage and drainage of water discharged. The Water Inc. has the objective to provide adequate services for water users; ensure equal treatment in the provision of the services provided for all users; it calculates and charges fees for services provided; take measures for rational use of water, reducing water losses to a minimum; take measures to protect the water; works with the assets in a thoughtful and cost-efficient manner, and maintains and ensures efficient and sustainable use of the waters and the system by which it operates.

The Law on Communal Activities (LoCs)[14] regulates the basic conditions and the manner for performing communal activities, their financing, financing of construction and maintenance of communal infrastructure etc., and states that communal activities are of public interest. It also states that the communal activities shall be performed on the basis of the development plans and programmes for communal activities (every 3 years). The Public enterprises (PUCs) founded by the municipalities and the City of Skopje for performing communal activities must, before the end of each year, adopt annual programmes for the following year, and prior to their implementation they must be approved by the municipal council / City of Skopje Council. The responsibility for providing conditions for the performance and development of the communal activities, lays within the founder of the PUCs (the Government of the Republic of North Macedonia, the municipalities, the municipalities in the city of Skopje and the City of Skopje), which shall ensure:[15] The material, technical and other conditions for construction, maintenance and operation of the communal infrastructure facilities and ensuring technical-technological unification of the systems for permanent and continuous provision of communal services. The necessary quality and volume of communal services depending on the material capacity of the municipality, the municipalities in the city of Skopje and the City of Skopje, and the control of the legal entities and natural persons providing communal services." The LoCs regulates also the possibility for the municipalities to cooperate for the provision of communal services; the cooperation is on a voluntary basis. According to the LoCs the municipalities, the municipalities of the City of Skopje and the City of Skopje regulate by decision or communal orders, the details regarding the organization and performance of the communal activities in their territories, as well as the use of communal services. This law also regulates the funding resources applicable to communal utilities. The Government may participate in funding the construction and maintenance of the facilities of the communal infrastructure, if they are of State importance or are covering the territory of several municipalities, in accordance with the plans and programs for the development of communal services. The participation is not mandatory. LoCS provides the legal basis for the adoption of regulations on local level (Local Self Government Units) to define the manner of the organization and providing communal services and manner for the use of communal services.

The Law on Drinking Water Supply and Sewerage of Urban Waste Waters (68/04, 28/06, 103/08, 17/11 and 54/11) regulates the conditions and manner of supplying drinking water, the interruption of the supplying of drinking water and disposal of urban waste waters in a recipient through water supply and sewerage systems, construction, maintenance, protection and connection of water supply and sewage systems, relationship between provider of the service and the clients, as well as the supervision over implementation of the law itself.

Law on inland navigation (55/2007, 26/2009, 22/10, 23/11, 53/11, 155/12, 15/13, 137/13, 163/13, 42/14, 166 / 14.146 / 15 193 / 15.31 / 16) regulates the internal navigation and safety navigation of inland waters in the country, conditions and manner of use, maintenance and protection of navigable roads, ports, berths and bathing zones, nationality, identification, registration and deletion of vessels, crew vessels, act in the navigation accident; removal of sunken vessels, the competence Port, supervision and other issues relating to inland waterways. It is not fully harmonized with the related EU legislation and policies. Relevant EU legislation has been transposed in the area of inland waterway transport, with the exception of the Regulation on recognition of certification and transportation of goods and passengers. An authority responsible for inland waterways has been established. The country actively participates in the EU Strategy for the Development of the Danube Region. It also signed the main international agreements on inland waterways, as well as a number of bilateral agreements with neighboring countries.

The Law on Fisheries and Aquaculture (7/2008, 67/10, 47/11, 53/11, 95/12, 164/13, 116/14 and 154/15, 39/16) regulates fisheries (fish harvesting for commercial purposes as well as aquaculture in several types of fishing grounds) planning and management including trade, facilities, records keeping, protection of exploited species etc. It is not fully harmonized with the related EU legislation and policies. The country is moderately prepared in the area of fisheries. Good progress was made on monitoring, inspection and control of catches as well as on fish health surveillance. There was improvement in fish stocks management in trans-boundary lakes. Providing information on sustainable exploitation of fish stocks and species might be considered.
The Law on the Protection of the Ohrid, Prespa and Dojran lakes (1980, revised in 1993) gives a clear perspective with regard to the protection of the three lakes and the range of their natural, aesthetic and cultural values. The objective is to keep them in original condition, create favorable conditions for maintaining and development of natural life, prevent acts that can cause adverse effects etc.

Other laws may be applicable for the sub basin management

[14] Official journal of Republic of North Macedonia no 95/12, 163/2013, 42/2014 and 44/2015.
[15] The RM Government, municipalities, the municipalities of the City of Skopje and the City of Skopje

The Law on Spatial and Urban Planning (No. 51/2005, 137/2007, 91/2009, 124/10, 18/11, 53 // 11,144 / 12, 55 / 13.163 / 13.42 / 14) determines the basic principles[16] regarding the organization of space. It regulates spatial and urban planning, i.e. spatial levels for which spatial or urban plans should be prepared including the types (see also section 1.4 and 2.1) and content of the plans as well as the procedure for their elaboration, adoption and implementation including monitoring of enforcement. The law incorporates related EU regulations and standards. The Law on Real Estate Cadastre adopted in 2008 changed the name of the State Authority for Geodetic Works (SAGW) to the Agency for Real Estate Cadastre (AREC). Included in its new list of responsibilities in the Law is the task of coordinating the establishment of an NSDI for North Macedonia in line with the EU INSPIRE Directive. Agency for Real Estate Cadastre has since 2010 been actively working in the field of data and service standardization. Adoption of the NSDI Strategy by the Government of the Republic of North Macedonia in June 2012 constituted a path towards the implementation of the Macedonian spatial data infrastructure.

The Law on Environment (53/2005 amended 81/2005, 24/2007, 159/2008, 83/2009, 48/10, 124/10, 51/11, 123/12, 93/13, 42/14, 44/15) is the basic piece of legislation for environmental protection. The objectives[17] of the Law are: preservation, protection, restoration and improvement of the quality of the environment; protection of human life and health; protection of biological diversity; rational and sustainable utilization of natural resources; implementation and improvement of measures aimed at addressing regional and global environmental problems. The Law provides for basic instruments and procedures such as environmental permits, EIA procedure etc. A Decree (OG No. 147/08 - it fully transposes the Directives 2003/35/EC18, 85/337/EEC and 96/61/EC) regulates public participation in the process of development of regulations and other acts, as well as plans and programmes in the area of environment.

The National Set of Environmental Indicators for the following chapters was adopted in 2008: air, water, soil, energy, fisheries, biological diversity, climate change, transport, agriculture, tourism, waste and health.

In the area of horizontal legislation, the national strategy on environment and climate change still needs to be adopted. Structural administrative capacity at a central and local level remained weak and insufficient. Priority measures were identified to strengthen the implementation of environmental legislation at local level. The environmental impact assessment and the strategic impact assessment process need to be further improved to ensure effective public participation. This applies in particular for projects in the hydropower sector and other infrastructure projects in national protected areas, areas of high natural value and potential Natura 2000 sites. Further work is needed on transposing and implementing the remaining horizontal environmental directives, such as the Environmental Liability Directive, INSPIRE and the Environmental Crime Directive.
As regards industrial pollution and risk management, alignment with most EU directives and regulations (the Industrial Emissions Directive and the Ecolabel and Eco-Management and Audit Scheme Regulations) is at an early stage.

In 2015 a **Law on environmental inspection** was drafted. Information and reporting system for inspection services was also developed and the software works well in its initial stage. The purpose of this draft law is the establishment of an inspection supervision that will be carried out based on prior multi-year planning of the inspection in the environment

[16] Such as: equal spatial development, rational organization and use of space, sustainable development, protection and improvement of the environment and nature, protection of the realty cultural heritage, protection from natural and technological disasters, transparency with regard to the adoption and implementation of the plans.
[17] According to the law these objectives shall be achieved particularly by: 1. Forecast, monitoring, prevention, limitation and elimination of the negative impacts on the environment; 2. Protection and development of environmental areas; 3. Preservation of the clean environment and remedy of the damaged parts of the environment; 4. Prevention of risks and hazards to the environment; 5. Encouraging the use of renewable natural energy sources; 6. Encouraging the use of products and application of cleaner production and use of clean technologies that are most beneficial to the environment; 7. Integrated approach to environmental protection and economic development; 8. Establishment of a system of planning of environmental protection, improvement and management; 9. Provision of funds to finance the measures and activities aimed at environment protection and improvement; 10. Control over activities that may pose a threat to the environment; 11. Raising of awareness regarding the needs of environmental protection in the educational process; 12. Harmonization of economic and other interests with the requirements for environmental protection and improvement; 13. Public and relevant institutions information on the state of the environment and their involvement in environmental protection; 14. Establishment of links between the institutions of the country dealing with environmental protection, with the relevant international institutions. 15. Restraining the greenhouse gas concentrations in the atmosphere; 16. Combating desertification and mitigating of effects from draughts.
[18] Directive 2003/35/EC on public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice, Council Directives 85/337/EEC and 96/61/EC.

at the central and local level, which is based on established criteria for assessing the risk that have the subjects of the inspection in the environment. The planning of inspections in the environment will enable inspection supervision according to the priorities and real needs that will allow better implementation of environmental legislation by the entities, while also affect the provision of rational and objective use of the material and human resources in the implementation of inspection which aimed at fulfilling the ultimate and only goal, which is improve the quality of the environment. The law on environmental inspection needs to be adopted without any further delay. Successful implementation of the law may be considerably hampered by the existing law on inspection supervision, which is not in line with EU acquis and relevant best practice.

The Law on Waste Management (68/2004, 71/2004, 107/2007, 102/2008, 143/2008, 124/10, 51/11, 123/12, 147/13,163/13, 51/15, 156/15; 63/16) aims among others at: sustainable development through protection of natural resources; prevention of negative impacts of waste on the environment, human life and health; environmentally acceptable waste disposal and; high level of protection of the environment, human life and health. It is referred to all types of solid waste and provides general rules applying on a number of issues[19]. It introduces the Precautionary Principle and the "Polluter Pays" principle in waste management. The Law has important links to other legislation, in particular to the Law on Environment (with regard to environmental permits, EIA procedure)[20]. It does not cover though, all obligations given in Waste Framework Directive (2006/12/EC) and in Hazardous Waste Directive (91/689/EEC). The Law provides the basis for the adoption of secondary legislation to regulate specific areas in waste management practice at all levels. The 2008 amendments regulate permitting procedures and sets technical and other conditions for waste storage and transfer, for acceptance to landfill and for the landfill operations.

Regarding waste management, the legal framework is partially aligned. Further alignment on special waste streams is necessary. The implementation of the Waste Directives is still at an early stage, and the actions set out in the adopted regional waste management plans are only partially implemented

The Law on Nature Protection (2004, as amended in 2006, 2007. 2010, 2012, 2013)[21] determines the way that protection of nature should be carried out providing in this regard for integration with other sectors. This Law has the following objectives: conservation and restoration of the existing biological and landscape diversity in a state of natural balance; establishment of a network of protected areas for the purpose of sustainable protection of the features on the basis of which they have acquired the status of natural heritage; providing for sustainable use of natural wealth in the interest of the present and future development, without significant damage of parts of the nature and with the least possible disturbance of natural balance; prevention of harmful activities of individuals and legal entities and disturbance in nature as a result of technological development and performance of activities i.e. providing for the best possible conditions for protection and development of the nature; providing for the citizen to exercise their right to a healthy environment. This Law provides for a re-evaluation and re-proclamation of the existing protected areas and the integration of habitats and sites under different management structures; for Strict Natural Reserves, National Parks and Natural Monuments this proclamation should be made by law while for the remaining categories proclamation can be made by government decision. The re-evaluation should have taken place within three years after the adoption of the new law. Public consultation during the proclamation process is obligatory.

The requirements for management planning e.g. contents of site management plans as well as the annual work plans are set out and the functions and regulations for the various management zones defined, along with the rights and responsibilities of land owners within the territory of protected areas. Details of measures for protection and the functions of rangers are also provided.

Further regulations are under development to guide implementation of the law; these include the Cadastre for Protected Areas, the Register of Natural Heritage and the rulebook for evidence on the trade and other activities with protected species. Other supporting bylaws and regulations concern collection of wild species, financing of protected

[19] i.e. definitions and applicability regarding types of waste; strategy, plans and program formulation at different levels including municipal; competent authorities to draw up waste management procedures and issuing permits for transportation, storage, treatment, processing of waste, waste disposal (this is subject to integrated environmental permits), handling of hazardous waste etc.; landfills (operation etc.); monitoring, reporting, data management; supervision of competent authorities; punitive provisions; etc.

[20] It is also closely linked to the Law on Organization of the Organs of the State Administration, Law on Local Self Government, Law on Public Enterprises, Law on Physical and Urban Planning, Law on Investment Constructions, Law on Concessions, Law on Public Procurement and Law on Waters.

[21] The Law on Nature Protection and the Law on Hunting transposes the Wild Birds Directive (79/409/EEC).

areas and delegation of management authorities. Implementation of the requirements of the Law on Nature Protection is an issue; amendments to enable its implementation to be more effective are found to be required (see also related paragraph under section 3.3.2 “Nature Protection”).

The Law on Forests (64/ 2009) regulates among others uses[22], nurturing[23] and protection[24] of forests as well as reproduction, forest economy, planning, enforcement of the law and penalties for non-compliance.

[22] i.e. logging, collecting and production of forest by-products, tourism, hunting and recreation
[23] i.e. maintenance, renewal, melioration and reconstruction
[24] i.e. protection from plant diseases, illegal logging, fires, illegal collecting of forests by-products etc.

4. Integrated water management Institutional Framework in North Macedonia

4.1 Overview

Basic legal document setting the institutional frame for water management is the Law on waters (OJ. 87/2008, 6/2009, 161/2009, 83/10, 51/11, 44/12, 23/13, 163/13, 180/14, 146/15)[25] regulating the framework for institutional setup and competences of state administrative and local self- government authorities. The management of waters incorporates activities for planning and undertaking measures and activities for rational and efficient use of waters, protection of waters and control of pollution and protection from adverse effects of waters. According to the WL, the Ministry of Environment and Physical Planning (MoEPP) has the leading role in water management process. T**he Ministry of Environment and Physical Planning (MoEPP)** has the leading role in water management legislation, with management and coordination role in all aspects of water management covered by the WL including: planning, implementation and enforcement, and exclusive role in the water management. With respect to planning, MoEPP is responsible for the preparation of the National strategy for waters and Water master plan, as well as the preparation of the RBMPs. In terms of implementation, the MoEPP has a leading role in the management of (international) river basins, which incorporates the protection of waters from pollution, protection against harmful effects of water (floods and erosion), preparation and management of monitoring activities, water permitting, concessions for water use, water management services (in collaboration with Ministry of Transport and communications, Ministry of foreign affairs and ministry of health), identification of deviations in water quality (in collaboration with Ministry of agriculture and water economy), establishment of measures in early warning plans (in collaboration to Crisis management centar), establishment and maintenance of the water book, cadastre for water pollutants, information to the public, definition of the contents of reports. The Specific responsibilities and obligations are shared among several other ministries in their respective areas of competence. The Law on waters defines that the management of waters is to be carried out on a river basin district basis[26], as hydrographical units- districts, which are independent of the administrative territorial borders[27]. The Ohrid Lake Sub basin is a sub basin of the national Crn Drim River basin district i.e of the river Drim, belonging to Adriatic international river basin district[28]. The sub basin area is situated within the administrative borders of three municipalities: Ohrid, Debrca and Struga.

[25] Transposing the WFD 2000/60/EC and daughter directives

[26] Ibid. Art 7 paragraph 2;

[27] Ibid. Article 4 paragraph 1 point 15

[28]The RBD Crn Drim to the east extends to the confluence of the river Vardar, on south to the Macedonian-Greek and Macedonian-Albanian border. To the west it extends up Macedonian-Albanian border, and to the north to the Macedonian-Kosovo border. In the basin of the Black Drim in the southern part, with its catchment areas include the Prespa Lake and Ohrid lake, and in the north with its own drainage area river Radika is also included. The Law on waters in Article 7: "The water resources management shall be carried out according to river basins, in hydrographic units separated by water courses of the river basins, taking into consideration the interconnection of the surface waters and groundwater, while the administrative and territorial border of the municipalities, the municipalities in the city of Skopje and the City of Skopje shall not constitute an impediment to the integrated management of river basin areas".On delineation of the RBD the boundaries see Decision on boundaries of the river basin management districts (OJ RM 107/12), mk version available at internet page: Одлука за определување на границите на подрачјата на речните сливови

4.2. Central level authorities - Legislative and policy development competences

The Assembly is the supreme legislative institution of the country. It has the power to adopt the relevant laws and to adopt the strategic and planning documents on the national level – the National Strategy for waters (NWS) and the Water Master Plan (WMP).

The Government is the supreme executive body of the country. It is responsible for adoption and endorsement of documents and acts submitted by respective ministries and take some high level executive state decisions in water management. The Government has the power to establish the National Water Council (NWC) and endorse the River Basin Management Councils (RBMCs). According to the WL, the Government is tasked with submitting the NWS and the WMP to the Assembly for adoption. The Government also has the mandate to adopt River Basin Management Plans (RBMPs) and sub plans and monitor their implementation. In terms of water management, the Government is involved in the following decisions: revocation of permits, determination of environmental objectives, water classification and categorization, adoption of the programme for collection and treatment of wastewaters, award of concessions, adoption of the criteria for monitoring network, adoption of state monitoring network for surface and groundwater bodies, adoption of contents of reports, manners and procedures, adoption of early warning plans, adoption plan for water management for use of water funds elaborated by MoEPP; adoption of method of calculation of total charge and price of services.

4.3. Central level authorities - Executive competences

According to the Law on waters, management of the waters (i.e. the undertaking of measures and activities for sustainable, rational and efficient use of water resources, protection of the waters and protection from adverse effects of waters[29] is the competence of the **Ministry of environment and physical planning** and its organizational units established for each river basin districts, in the case of Crn Drim RBDs – the Crn Drim RBD Unit[30]. The organizational unit is established within the Administration of Environment under the Water Department.

The Environmental Administration (EA) is body within the MoEPP, established by the Law on Environment (LoE), performing water management functions as prescribed by the Law on Waters. It is the administration ensuring the fulfilment of the MoEPP responsibilities in the area of water management. As defined in WL art. 222, EA implements all expert and technical activities and measures on the territory of each river basin district.

The Department of Waters (DW) within EA has the leading role in the implementation of the WL provisions having jurisdiction over:

- preparation of planning and programming documents in the area of waters, which includes: the National Strategy for waters, the Water Master Plan, the Water Management Funding Programme; monitoring of their implementation; collection, provide expertise and cooperate with other units within the MoEPP and governmental and non-governmental institutions regarding their area of interest.
- activities for granting concessions for: use of water for electricity production, bottling water for commercial purposes, cultivation of fish and waterfowl, lake traffic and provision of touristic, sport and other recreational services accompanied with construction of permanent facilities. This unit deals with coordination with other ministries for provision of opinions on the proposal for concession; economic analysis of the water use and record keeping of the applications for concession and concession contracts.
- permitting in accordance with RBMPs – content of the permits, issuing permits for water use of surface and ground waters, permits for waste water discharges and permits for excavation of sand, gravel and stones of the river beds and river sides; provides opinion for awarding concessions for exploitation of mineral resources. It shall deal with issuing water management consent for construction of facilities in accordance with Water Master Plan and RBMPs, including participate in the technical committees for inspection of facilities with granted consent. The Crn Drim River Basin Management Unit of the water depertment, have comprehensive set of activities and responsibilities related to development and implementation of RBMPs, including:

[29] Ibid. Art 4 paragraph 1 point 51
[30] Ibid. Art 8 paragraph 2 and 3, recognized according the Law on Waters, unless otherwise defined – which means that some of the water management competences rest within other state administrative bodies or competent authorities of the local self government units (municipalities and the City of Skopje)

- caharacterization - the assessment of the characteristics of each river basin
- assessment of the significant impacts and effects on the status of the surface waters and ground waters caused by human activity;
- preparation of information and a mapping of the registered protection zones;
- preparation of information and a map of the activities for monitoring the status of the waters and the monitoring programs;
- preparation of environmental objectives for every body of water in the river basin, including the information about the deviations, contain the measures planned and taken for the purpose of improving the quality of the waters and achieving the environmental objectives;
- economic analysis for water use, including a report for application of the user pays principle;
- coordinates the preparation and update (each 6 years) of plans for river basin management;
- preparation of a environmental objectives and program of measures,
- implementation of the plan for river basin management;
- program for protection against harmful effects of waters as well as the basic measures for protection against floods;
- implementation of the program of measures for achieving environmental objectives;
- ensures management of the part of the international river basin located in the territory of the Republic of North Macedonia in accordance with law and international agreement ratified by the Republic of North Macedonia;
- ensures the implementation of measures for protection against harmful effects of water in the respective river basin;
- detailed programs and plans for water management of river basins and sub-basins;
- fulfillment of the obligations related to water resources management taken by international agreements ratified by the Republic of North Macedonia; participates in drafting the basic assessment of the characteristics of each river basin management section provides the area of the international river basin is located in the territory of the Republic of North Macedonia in accordance with law an international agreement ratified by the Republic of North Macedonia;

The Crn Drim RBD management Unit is also competent to conduct the following activities within its territorial jurisdiction

- activities and results from the participation of the public in preparation of the plan;
- participates in coordination with the bodies of the basin and sub- bodies.
- organizes and supervises the program tasks and activities in these areas, cooperate and coordinate cooperation with other organizational units in the ministry, government agencies, scientific and professional institutions and non-governmental organizations from the country and abroad, coordinate activities related the preparation of the scientific studies and expert reports.
- approves and participate in the development of programs, plans and reports on the bodies of the basin and the bodies of sub-basins
- carries out the necessary tests to determine the bearing, the amount and properties of water and requires taking necessary measures to protect groundwater found in geological research or exploitation of mineral resources, mining tunnels, and other activities of the excavation or drilling on land ;
- professional activities in the issuance of licenses
- conducting scientific - research activities in the field of water

4.4. Central level authorities - Other executive competences

The establishment and management of the international river basin districts is shared competence between **MEPP and the Ministry of Foreign Affairs (MFA).** According to the relevant Law provision, besides the legal provisions, relevant for the establishment and management of the international RBD are as well the provisions of the international agreement/treaty ratified by Republic of North Macedonia. Thus, the establishment and management of the international RBDs are conditioned by the existence of an international legally binding instrument subject to ratification[31].

[31] According to the Law on conclusion, ratification and enforcement of the international treaties (Official Journal of Republic of North Macedonia no. 5/98), treaty is defined as an international agreement concluded between Republic of North Macedonia (i.e. the President or the Councils of ministers- the Government on its behalf) in written form with one or more states or international organizations determining rights and duties for the State governed by the Constitution of Republic of North Macedonia and the international law, irrelevant whether embodied in a single instrument or in two or more related instruments, and which defines . Only

The Ministry of Economy (MoE) is responsible for cooperation to MoEPP for preparation of proposals for concession for water use. Its area of competence covers ground waters, use of mineral and thermo-mineral resources and electricity generation. MoE also provides input to the NWS and has limited responsibilities in the area of monitoring.

The Ministry of Transport and Communication (MoTC) is responsible for communal infrastructure, issues of waters supply and collection, drainage and treatment of wastewaters especially the aspect of construction and management of water management facilities.

The Ministry of Health (MoH) has its major role in the implementation of the Drinking Water Directive. The cooperation between MoEPP and MoH ensures the link between water management and protection of human health. MoH through its Food Directorate identifiers the water bodies suitable for human consumption and bathing waters, control of the sanitary and protective zones around these bodies, safety of drinking and bathing waters and protection of population from waterborne diseases. It is involved in the area of water protection and creating the above mentioned link through the Institute for Public Health, and, in the area of enforcement, the State Sanitary and Health Inspectorate. The role of **the Institute for Public Health** (IPH) in the water management system is related with the monitoring of drinking water and surface waters. Within IPH coordinates the work of the regional institutes for hygiene and health ecology, which form a monitoring system for drinking water and surface waters. The monitoring is performed according harmonized methodology in form of programme activities. At the region of the Ohrid lake sub-RBD a public health centers operate in Ohrid and Struga. The IPH is obliged to submit data from the water monitoring to MEPP on regular basis.

The **Energy Regulatory Commission** of the Republic of North Macedonia has competence to determine tariffs for water management services[32]. The Energy Regulatory Commission has jurisdiction over the procedures and criteria for determination, but also enforcement of the operations of **the providers of water services[33]** in regards to the application of this law.The management, utilization, operation and maintenance of hydro-systems and irrigation and drainage systems is competence of a **joint stock company "Water Management of the Republic of North Macedonia"** (Joint Stock Company is established and operating under the provisions of the Company Law and owned by the state. The herein after: Water Inc.)[34] The newly established company has headquarters located in Skopje and the remaining 12 branch offices. The Crn Drim brench office is based in Ohrid, with an area of activity on the territory of Prespa (Municipality of Resen), the municipalities of Ohrid, Struga, Vevcani, Centar Zupa, Debar, Kicevo and Plasnica [35]. The main activity of the Water Inc. is public utility services, i.e. water supply for irrigation and drainage of land and construction and ongoing maintenance and investment in the systems. Water Inc. will use, maintain and manage the irrigation and drainage as a whole, in order to:

- Supply of irrigation water;
- supply of the communal enterprises with water intended for human consumption (drinking water and other uses);
- supply of water for industrial and technological (economic) needs including the production of electricity;
- Regulation of watercourses/ river beds;
- drainage of land and
- drainage of discharged waters.

Water Inc. is also competent to :
- construct and maintain facilities for the protection and defense from floods;
- construct and maintain facilities for prevention and protection from erosion;

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these agreements are considered to be subject of ratification. International agreements and acts of the other competent authorities for implementation and enforcement of the international treaties are not considered as such and do not impose new duties for the state.

[32] OJ R North Macedonia 7/2016

[33] Water service provider "is a legal entity established or designated by by a state or local government to provide one or more water service area of one or more municipalities, the municipalities in the City of Skopje. "Water services" are services provided by the water services provider as basic services to their end users and covering supply of raw water and / or drinking water and the collection and disposal of urban sewage and / or waste water treatment;

[34] Official journal of Republic of North Macedonia no 72/2015 The Law terminating the Law on water communities is also important for some organizational aspects and definition of competences for flood management.

[35] Water Inc. is established to conduct water management activities throughout the entire territory of North Macedonia. Water Inc. has headquarters and branch offices to perform services over certain geographical area. Each branch offices will have determined area of action by the statute of Water Inc. The systematization of the posts will be a subject matter to an Regulation on internal systematization of the Water Inc

- construct and maintain facilities for regulation of the rivers and torrents.

The Ministry of Agriculture, Forestry and Water Management through the Administration for Water management performs expert supervision over the operations of Water Inc. the MAFWM has the right to require the managing board insight into documents of financial, material and other natural and indicates illegal operations and procedures that hinder normal operations..

The Department for Protection and Rescue (DPR) is an independent state body under the Government of RM, established with the Law on Protection and Rescue (LoPR). In the area of water management their activity is related to the specific responsibility to cooperate with MoEPP in consultations on measures for protection against floods.

The Centre for Crisis Management (CCM) is an independent state body under the Government of RM, formed to propose decisions, ensure permanent consultation, coordination, timely reaction and efficacy in cases of crises, as well as to ensure assessment of safety and risks throughout the country. The CCM is entitled to receiving early information on quantities and levels of water from the Administration for Hydro-meteorological Service (AHMS). It also proposes to the Government of RM early warning plans in accordance with MoEPP. (More on the stakeholder analysis for floods and other harmful effects of waters see the Report on SRBD institutional arrangements for against harmful effects of waters- Annex II of the Report)

The Administration for Hydro-Meteorological Service (AHMS) is the national authority for meteorology and hydrology. As per the Law on Hydro-Meteorological Activities, AHMS regulates the meteorological and hydrological matters and is authorized for implementation of maintenance and development of meteorological and hydrological observation network and measurements; monitoring and research of atmosphere and water resources; and the application of meteorology and hydrology. AHMS acts of hydrological observance are performed continuously and present single hydro-meteorological information system. AHMS is part of the State hydrological monitoring network. AHMS establishes and develops banks of hydrological data and water data, published in annual reports. AHMS is obliged to inform the public on the state of waters and alarm on the appearance of imminent dangerous or harmful hydrological circumstances. According the WL, AHMS also provides any information about quantity and level of water to the CCM before critical levels are reached.

The Hydro-Biological Institute (HBI) as an independent scientific institution performs monitoring over the three main natural lakes in the country – Ohrid Lake, Prespa Lake and Dojran Lake. The HBI is an education and research organization focused on hydrobiology issues in the area of natural lakes, artificial lakes and rivers. It is responsible for monitoring of physical and chemical composition of water in natural and artificial lakes. Due to the fact that the Ohrid sub basin extends over natural lake of Ohrid, this institute has high impact/interest for this RBD.

4.5. Central level authorities - Enforcement competences

The **Inspection Council** is an independent state body acting as a legal person, formed in order to implement the scope of responsibilities defined by this law, an in particular coordination of the work of the inspectorates. The following inspectorates are entitled to survail empowerment of the water management related legislation:

The State Environmental Inspectorate (SEI) is empowered to implement the MoEPP responsibilities in the area of enforcement of environmental legislation and, in particular, water management legislation. It covers the obligations for inspection surveillance on central level in the field of environment and, respectively, in the field of water management.

The State Communal Inspectorate (SCI) possesses jurisdiction in the area of public water supply systems and systems for collection, drainage and wastewaters treatment, implemented through its state communal inspectors. The State Inspectorate for Agriculture (SIA) possesses jurisdiction with regard to control of the nitrate vulnerable zones and irrigation and drainage.

The State Sanitary and Health Inspectorate (SSHI) possesses jurisdiction regarding drinking waters and bathing waters. SSHI performs surveillance over the surface water bodies, recreational basins, and bathing zones.

4.6. Consultative bodies

The National Council for Waters (NCW) has been established with the purpose of advising on issues for water management, harmonization and coordination of the needs and interests, as well as proposal of various measures for preservation, protection and improvement of the water regime in the territory of the country. The members of the National Water Council were appointed with decision of the Government of 12 December 2009 (Article 219, par 5 of WL). The NCW comprises of members proposed by the following institutions: MoEPP, MoH, MoTC, MoE, MoAFWE, Association of LSG Unites, Macedonian Academy for Science and Art, Non-governmental sector and the River Basin Management Councils. Currently the NCW is not in operation.

The River Basin Management Councils (RBMCs) have to be established for each river basin, and on voluntary basis for sub-basins, with the purpose of preparation, implementation and monitoring of the river basin management plans, and for proposing measures for improved water management. According to Article 66 of the Law on Waters the opinions of the RBMC are taken into consideration in the planning process at all stages, from beginning to end.

The decree[36] stating the general composition of the Crn Drim River Basin Council is composed of most 35 appointed members representatives of MoEPP, MAFWE,MH, and MTC; representative of municipalities Resen, Ohrid, Struga and Debar, Debrca; one representative of the Economic Chamber of North Macedonia - of hydroelectric operators (EVN); two representatives of associations of non-governmental organizations; The Alliance of farmers; representative of the Union of Fishing Societies of the Republic of North Macedonia; one representative of the proposal of the Association of Community Service Providers "ADKOM" (ProAkva); one representative from among the larger industrial facilities (IPPC instalations) operating – usingwaters / discharging wastewater; one representative of consumer organizations; and one representative of the Council for management of a part of the river basin district is established.

4.7. Protected areas

In 2006, the Government of the Republic of North Macedonia adopted a decision[37] for the establishment of a public institution for management and protection of the National Park Galicica- **The Public institution National Park "Galicica".** The basis for this decision is contained in the Law on Nature Protection and the Law on Institutions (Official Gazette No. 32/05). The main activity of **National Park Galicica** is management and protection of nature, biological and landscape diversity and natural heritage through:

- protection of natural habitats of national and international significance for cultural, scientific, educational and tourist-recreational purposes;
- establishing stability of ecological processes and biological and landscape diversity through permanent preservation of representative physico-geographical regions, biocenoses, genetic resources and species in an authentic state;
- creating conditions for tourism development in accordance with the principle of sustainable development;
- realization of cultural, scientific, educational and recreational goals, which at the same time maintain the natural state of the national park;
- sustainable use of natural wealth in the interest of current and future development, without significant damage to the parts of nature and thus minor disturbances of the natural balance;
- creating conditions and undertaking measures for the protection of the national park in order to preserve and rational management of certain components of biological and landscape diversity, as well as sustainable and rational use of natural wealth;
- studying, researching and scientific methods dealing with issues of interest for the protection of the national park;
- keeping records and documentation of natural and other values and beauties in national park (position, degree of endangerment, protection measures);
- adopting and implementing strategies, programs, management plans, conditions and measures for protection of the national park;
- undertaking measures for protection of the identified zones in the National Park;
- providing incentives and support to the protection of the national park through raising public awareness, and especially in the educational process;

[36] Governmental Decree on the composition, manner of participation, and the manner of nomination of the representatives in the RBMCs OJ 106/2013
[37] No. 19-4971 / 1-05

- determining the components of biological and landscape diversity and their endangerment;
- establishing a regime for the protection of the national park;
- prevention of harmful activities of natural and legal persons and disorders in national park as a consequence of technological development and performing activities, ie providing maximum favourable conditions for the protection and development of nature;
- encouraging scientific research in the field of protection of the national park;
- publishing scientific and expert publications, guides, slides, postcards and others informative and propaganda material for the national park;
- encouraging and developing interest and attitude towards keeping the national park through organizing exhibitions, displaying films, lectures and other forms;
- production, purchase and sale of medicinal and aromatic plants, fruits and seeds;
- construction of infrastructure and arrangement of springs, taps, picnic sites and recreation areas and more;
- protection, breeding and shooting of wildlife, as well as protection and protection collection of wild species of plants and fungi and other forest fruits;
- protection, breeding and traditional fishing of the fish fund;
- other things that contribute to the protection and promotion of the national park.

4.8. Local level governance

The WL stipulates competences in water management not only with central but as well as to local administration too, especially in protection of water from small industry and communal waste waters, flood protection, erosion, water supply and water discharge and other issues. Through the decentralization process, the Municipalities will be key executive players in environmental protection in the future, and will provide most of the utility services. **At the local level**, LSG units are responsible for protection from, and prevention of, water pollution, drinking water supply, drainage, collection and treatment of wastewater. They carry out activities by the own local infrastructure as well as using infrastructure of the communal (municipal) enterprises, which are practically operating as public utilities. LSG units are also responsible for operation of the local monitoring network for the local water bodies within their respective areas; operation, maintenance, and development of the local monitoring network. LSG environmental inspectors carry out inspection functions enforcement for local level competences.

With the adoption of the Law on Waters, The LSGs receive a number of competences in water management[38]
The LSG are inherently competent for utilities: drinking water supply; and collection, disposal and treatment of sewage and storm water. The municipality has implemented activities through public utility/ **communal enterprises** (relevant for the Ohrid Sub River basin: Public Communal Enterprise PROAKVA and Public Communal Enterprise DEBRCA**.** The LSGs are also responsible for water protection, prevention and control of water pollution permitting the discharge of wastewater from B installations (integrated environmental permits) except for those in protected areas.

According to the Law on prices of water services these providers have a principal role in determination of the prices of water services and have an obligation to prepare a Plan for tariff adjustment for water services and Business plans for investment.The Plan for tariff adjustment for water service is based on data form the business plan of the provider of water serviceas well as on the methodology for setting tariffs for water services. It should clearly state the costs associated with the provision of water services, and the objectives to achieve in terms of increasing the efficiency and quality of water service as well as draft tariffs for water services for a period of three up to six years.

[38] They are obliged to collect, drain and purify waste water resulting from their region, to provide industrial and urban waste water properly treated before being discharged into recipients. For its public companies or legal persons entrusted performance of the activity for water collection, disposal and treatment of wastewater, the LSGs are obliged to obtain permit from the MEPP and permits for use and water discharge. LSGs are obliged to ensure the expansion of sewage systems, discharge of septic tanks, to ensure monitoring of bathing water and water control drinking manage the bathing zones within the territorial jurisdiction, to care and to record the wells used in their area, and to provide a regular supply of the population with clean drinking water. LSGs are also responsible for protection of harmful effects of waters includes activities related to the protection and defense against floods, erosion and torrents, defense against freezing of surface water bodies.

5. Transboundary level legal and Institutional structure

The Memorandum of Understanding for the Management of the Extended Transboundary Drin Basin, signed in Tirana on 25 November 2011 is the basic legal instrument for coordinated transboundary action. The Institutional Structure for the implementation of the Drin MoU is composed of:

1) The **Drin Core Group** (DCG) is given the mandate by the Ministers of the Riparians to coordinate actions for the implementation of the MoU. The Drin Core Group comprises of duly nominated representatives of the competent ministries of the Drin Riparians (Ministry of Environment, Forestry and Water Administration, Albania; Ministry of Environment, Energy and Climate Change, Greece; Ministry of Environment and Physical Planning, the FYR North Macedonia; Ministry of Agriculture and Rural Development, Montenegro; Ministry of Sustainable Development and Tourism, Montenegro; Ministry of Environment and Spatial Planning, Kosovo);

2) **The Joint Commissions/Committees** (Prespa Park Management Committee; Lake Ohrid Watershed Committee; Lake Skadar-Shkoder Commission; UN Economic Commission for Europe (UNECE); Global Water Partnership Mediterranean (GWP-Med); and the the Mediterranean Information Office for Environment Culture and Sustainable Development. As provided by the MoU the decisions of the DCG are taken by the representatives of the Ministries of the Riparians on the basis of consensus. The Drin Core Group has two ordinary meetings per year.

3) The **Secretariat** provides technical and administrative support to the DCG; . GWP-Med serves by appointment of the Parties as the DCG Secretariat.

4) Three **Expert Working Groups** (EWG) have been established to assist the DCG in its work:
- Implementation of Water Framework Directive EWG;
- Monitoring and Information Exchange EWG;
- Biodiversity and Ecosystems EWG.

5) An annual **Meeting of the Parties** reviews progress in the implementation of the MoU and its provisions. The Meeting of the Parties is annual meeting of the Ministers responsible for the management of water resources and/or environment of the five Parties. The mieeting of the parties reviews the progress in the implementation of the MoU and its provisions.

Stakeholder in the Ohrid Lake Sub River basin district – Albania

Stakeholder category	Relevant stakeholder	Territorial Jurisdiction	Matter Jurisdiction
LEGISLATIVE AND POLICY DEVELOPMENT COMPETENCES	**The Assembly of Albania**	Central level	Legislative and policy development : Laws; ratification of international agreements for RBD management
	The Council of Ministers	Central level	Legislative and policy development: approves the composition and regulation of operation of the National Water Council; and the manner of organization and functioning of the Water Resources Management Agency; approves the National Strategy of Water Resources Management; appoints a special commission for cross-border water management; determines the territorial boundaries of each basin waters of the Republic of Albania, as well the center of council composition of each of them; approves the hydrographic boundaries of basins water; approves the river basin management plans; determines areas, distances and width of the shores of water resources
	National Water Council	Central level	central decision-making body responsible for managing water resources: approves interregional and national plans and projects in the field; takes appropriate measures for the implementation of any international agreement, water management conventions of which the Republic of Albania is a party; issues permits and authorizations for water use and discharges when the activity is performed outside the boundary of a single basin; approves the initiatives of any contracting authority for initiating concession procedure for the use of water resources; approves the regulation of the river basin councils Council, the water basin council and the water basin agency
EXECUTIVE COMPETENCES	**Water Resource Management Agency**	Central level and RBD level	central governmental body responsible for implementation of the water management regulations and the integrated management of water resources, quantitative and qualitative preservation, and their further consolidation
	Special Commissions for the Management of Transboundary Waters	Central level and RBD level	special commission tasked with the administration of transboundary waters, managing the relations with the border countries for these waters, based on Albanian legislation and relevant international agreements.
	Ministry of Tourism and Environment	Central level	drafting and implementing policies, strategies and national plans related to climate change, for the protection of aquatic resources, water resources, inland and temporary water surface, marine water and groundwater.
	National Environmental Agency	Central level	to monitor the state of the environment and to monitor the quality and quantity of water resources and to develop new policies for their protection and improvement. National Environmental Agency monitors wastewater discharges

	Regional Environmental Agencies	Regional level	responsible for permitting and enforcing environmental legislation
	The State Inspectorate of Environment, Forests and Water	Central level	enforcement of legislation on environmental protection, forests, water and fishery
	The Ministry of Agriculture and Rural Development	Central level	responsible for water utilization for irrigation purposes and drainage. This ministry is responsible for water utilization for irrigation, for drainage, for the protection of flood systems and for the preservation of fishery resources
	Directorate of Agriculture and drainage boards	Regional level	technical, specialized structures, responsible for operation and maintenance of drainage, flood protection systems and main irrigation infrastructure (large dams and main irrigation canals)
	Directorate of Water and Fishery Policies-The Fishery and Aquaculture Sect	Central level	drafting of policies, strategies for fishery and aquaculture development and the preparing of the Fishery and Aquaculture Administration Plan. This sector is also responsible for directing and coordinating the monitoring and controlling system for scientific research projects that relate to sea fishery resources, the evaluation of internal waters, and fishery information and statistics systems
	Ministry of transport and infrastructure: General Maritime Directorate; General Directorate of Water Supply and Sewerage	Central	elaboration of the policies related to water supply and sanitation. The authority is in charge of developing policies on water supply and sewerage systems, and for investing in waste management facilities
	Water Regulatory Authority	Central level	regulatory authority, responsible for regulating the sector of water supply and wastewater disposal and treatment in a Albania
	Ministry of Health	Central level	responsible for setting drinking water standards and monitoring the quality of drinking water, bathing water and curative waters, by protecting water sources and the chlorination of supply entering the distribution systems
	Ministry of Energy and Industry	Central level	responsible for hydropower production and power produced by renewable energy resources
	Ministry of Interior General Directorate of Civil Emergency	Central level	monitors, manages and controls states of emergency, including floods and other emergencies, in the entire territory of Albania
	Ministry of Economic Development, Tourism, Trade and Entrepreneurship	Central level	responsible for the planning and approval of tourism policies, and has the duty to ensure and protect the sustainable use of water resources for tourists
MONITORING CPMPETENCES	**Institute for Public Health**	Central level	monitoring the safety of water supply, including water chemical and biological monitoring
	The Administration for Hydro-Meteorological Service	Central level	operation of the hydrological monitoring network, to inform the public on the state of waters and alarm on the appearance of imminent dangerous or harmful hydrological circumstances
	Institute of Geoscience,	Central level	monitor surface water quality and quantity; studying

	Energy, Water and Environment		and evaluating the country's natural mineral and underground energy and water resources; for groundwater quality and quantity monitoring; for assessing surface water quality for rivers, lakes, underground and marine water; and for monitoring rainfall, temperature and other hydro meteorological parameters
	Albanian Geological Survey	Central level	groundwater quality and quantity monitoring. It also conducts the watershed hydro-geological studies and recommends measures for the protection of groundwater resources
POLICY AND EXECTIVE COMPETENCES AT LOCAL LEVEL	**Local self-government Unites (municipalities) And quarks**	Respectively at municipal level	sewerage and treatment of public waste water, and collection, transport and treatment of municipal solid waste and technological waste
	the river basin councils	River basin and local level	integrated management of water resources in the relevant basin at the local level. competent to issue authorizations and permits when the activity is to be carried out within the territory of the Republic of Albania and within the boundaries of a single basin
	water basin management offices- Agency branches	River basin	drafts the water resource plan for the respective basin and submits it for approval to the river basin council; inventory of water resources in quantity and quality, Promotes the participation of water users in the management and management of water resources; prepare reports; prepares materials for the meetings of the river basin council; surveillance over implementation of the decisions of the National Water Council and the river basin Council; prepare programs for preventing and avoiding contamination of receiving water resources under their jurisdiction from liquid discharges; compile the program of measures for the water basin; keep a register listing all licenses, authorizations, permits and concessions issued.
WATER USERS	**The Water Supply and Sewerage Association of Albania**	Central level	not-for-profit association of water supply and sewerage professionals formed by a group of representatives from eight water supply and sewerage enterprises in Albania, to represent the interests of the enterprises operating in the water sector, and to raise the level of professionalism
	Water User Associations (WUAs)	Local level	private and financially independent entities to manage the irrigation .
	Albanian Union of chamber of Commerce and industry	Central level	represent and promote the general interests of business chambers for the development of trade and industry at all levels
ORGANIZED INTEREST GROUPS	Environmental NGOs/associations; NGOs dealing with biodiversity conservation and nature protection; Consumer protection associations	Central and Local level	Public participation in the decision making process negotiate (lobby) on matters of public interest

Stakeholder in the Ohrid Lake Sub River basin district – North Macedonia

Stakeholder category	Relevant stakeholder	Territorial Jurisdiction	Matter Jurisdiction
LEGISLATIVE AND POLICY DEVELOP-MENT COM-PETENCES	**The Assembly of Republic of North Macedonia**	Central level	Legislative and policy development : LoW and other *lex specialis;* Water strategy, Water Master plan*; ratification of international agreements for RBD management*
	The Government of Republic of North Macedonia	Central level	Legislative and policy development : proposals LoW and other *lex specialis;* Water strategy, Water Master plan; Adoption of RBMP
EXECUTIVE COMPETENCES	**Ministry of environment and physical planning**	Central level	Legislative and policy development : proposals LoW and other *lex specialis;* Water strategy, Water Master plan< proposal, implementation of RBMP
	The Environmental Administration (EA)- The Department of Waters (DW)	Central level	Executive competences: **The Water Management Planning and Development, The Concession and Inter-Sectorial Cooperation, permitting procedures- water rights/consents,**
	Crn Drim River Basin Management Unit	River basin district	River basin management planning and implementation
	Ministry of Foreign Affairs	Central level	establishment and management of the international RBD ; conclusion of international agreement/treaty; ratification procedures
	The Ministry of Economy	Central level	proposals for concession for water use, covers ground waters, use of mineral and thermo-mineral resources and electricity generation;, including use of water by hydro power and thermal power plants
	The Ministry of Transport and Communication	Central level	responsible for implementation (financing) of infrastructure development programs and projects related to drinking water supply and wastewater collection
	The Ministry of Health, Food Directorate, Institute for public health, State sanitary inspectorate	Central and regional level	water bodies suitable for human consumption and bathing waters, control of the sanitary and protective zones around these bodies, safety of drinking and bathing waters and protection of population from water-borne diseases, hygiene and health ecology, monitoring of drinking water and surface waters, communal hygiene in public facilities, quality control and hygienic-bacteriological status, monitoring of waters
	Energy Regulatory Commission of the Republic of North Macedonia	Central level	determine tariffs for water management services and enforcement of the tariffs
	The Ministry of Agriculture, Forestry and Water Management, Administration for Water management	Central level	manages water use in agriculture (irrigation, land drainage, fisheries), large infrastructure facilities related to use of water such as dams, reservoirs, irrigation/hydro systems, etc. performs expert supervision over the operations of Water Inc. Good agricultural practices
	The Administration for Hydro-Meteorological Service	Central level	Tasked with responsibilities for monitoring the quantity and quality of surface and groundwater, operation of the hydrological monitoring network, to inform the public on the state of waters and alarm on the appearance of imminent dangerous or harmful hydrological

			circumstances
	National Park Galicica	National Park Area	managing the national park, the protection of nature, biological,landscape diversity and natural heritage
POLICY AND EXECTIVE COMPETENCES AT LOCAL LEVEL	**Local self-government Unites (municipalities) Ohrid, Struga, Debrca**	Respectively at municipal level	protection from, and prevention of, water pollution, drinking water supply, drainage, collection and treatment of wastewater. They carry out activities by the own local infrastructure as well as using infrastructure of the communal (municipal) enterprises, which are practically operating as public utilities. LSG units are also responsible for operation of the local monitoring network for the local water bodies within their respective areas; operation, maintenance, and development of the local monitoring network. LSG environmental inspectors carry out inspection functions enforcement for local level competences; determination of prices of water services
ENFORCEMENT COMPETENCES	**The State Environmental Inspectorate**	Central level	empowered to implement the MoEPP responsibilities in the area of enforcement of environmental legislation and, in particular, water management legislation. It covers the obligations for inspection surveillance on central level in the field of environment and, respectively, in the field of water management.
	The State Communal Inspectorate (SCI)	Central level	possesses jurisdiction in the area of public water supply systems and systems for collection, drainage and wastewaters treatment, implemented through its state communal inspectors. The State Inspectorate for Agriculture (SIA) possesses jurisdiction with regard to control of the nitrate vulnerable zones and irrigation and drainage.
	Authorized municipal inspectors	At LSGUs level	empowered to implement the LSGs responsibilities in the area of enforcement of environmental legislation and, in particular, water management legislation
OPERATORS – PUBLIC INTEREST SERVICE PROVIDERS	Joint stock company "**Water Management of the Republic of North Macedonia**" in state ownership Branch office "Crn Drim)"	territory of Prespa (Municipality of Resen), the municipalities of Ohrid, Struga, Vevcani, Centar Zupa, Debar, Kicevo and Plasnica	the water management services , is public utility services, i.e. water supply for irrigation and drainage of land and construction and ongoing maintenance and investment in the systems. Water Inc. will use, maintain and manage the irrigation and drainage as a whole, in order to Supply of irrigation water; supply of the communal enterprises with water intended for human consumption (drinking water and other uses); supply of water for industrial and technological (economic) needs including the production of electricity; Regulation of watercourses/ river beds; drainage of land and drainage of discharged waters; responsible for managing the environment, construct and maintain facilities for the protection and defence from floods; - construct and maintain facilities for prevention and protection from erosion; construct and maintain facilities for regulation of the rivers and torrents
	Public Utility/ Communal Enterprises"PROAKVA" ; PCE	At LSG level relevant for the DRBD	drinking water supply; and collection, disposal and treatment of sewage and storm water; Plan for tariff adjustment for water services and Business plans for

	"Debrca"		investment
CONSULTATIVE BODIES	National water council	National level	Provides independent opinion and improvement suggestions regarding development, ratification and implementation of water management regulating laws and bylaws; adoption of the national water strategy, river basin management plans, etc.
	Crn Drim River basin management council	river basin district	preparation, implementation and surveillance over the river basin management plans, and for proposing measures for improved water management, opinions of the RBMC are taken into consideration in the planning process at all stages, from beginning to end
ORGANIZED INTEREST GROUPS	Environmental NGOs/associations; NGOs dealing with bio-diversity conservation and nature protection; Consumer protection associations	Local level	Public participation in the decision making process
	Chamber of Commerce EVN North Macedonia,	Local level	Industrial capacities operation Dam regulation Public participation in the decision making process
	Farmers Association Fishing assosiations/ concessioner	Local lake level	Public participation in the decision making process, Good agricultural practice fishing

VALUATION OF ECOSYSTEM SERVICES OF THE LAKE OHRID WATERSHED

- VALUING THE NATURAL AND CULTURAL CAPITAL OF LAKE OHRID –

[LOWMP SUPPLEMENT II]

Table of Contents

Abbreviations

AMIS – Agricultural Market Information System (North Macedonia)
CICES – Common International Classification of Ecosystem Services
CVM – Contingent valuation method
DEM – Digital elevation model
EC – European Commission
ES – Ecosystem services
EU – European Union
FAO – Food and Agriculture Organization
GDP – Gross domestic product
GEF – Global Environment Facility
GWP-Med – Global Water Partnership – Mediterranean
HPP – Hydro power plant
IPCC – Intergovernmental Panel on Climate Change
IUCN – International Union for Conservation of Nature
LO – Lake Ohrid
LOW – Lake Ohrid watershed
LOWMP – Lake Ohrid Watershed Management Plan
MEA – Millennium Ecosystem Assessment
MAES – Mapping and Assessment of Ecosystems and their Services
MoU – Memorandum of Understanding
NC – Non-consumptive
NGO – Non-governmental organization
NP – National park
NUV – Non-use value
OECD – Organization for Economic Co-operation and Development
SHPP – Small hydro power plant
SSO – State Statistical Office (North Macedonia)
TEEB – Economics of Ecosystems and Biodiversity
TEV – Total Economic Value
ToR – Terms of reference
UN – United Nations
UNECE – United Nations Economic Commission for Europe
UNEP – United Nations Environment Programme
UNESCO – United Nations Educational, Scientific and Cultural Organization
UV – Use value
WB – World Bank
WFD – EU Water Framework Directive
WTP – Willingness-to-pay

1. Introduction

Situated in the south-west of the Balkan Peninsula, Lake Ohrid is one of Europe's largest lakes and, at somewhere between one and three million years, one of the world's oldest. It is a true diamond set in a majestic landscape dominated by high ranges and stroked by winds of the Adriatic and the Aegean, linked through underground channels to its companion over the mountains, Lake Prespa. The lake district is protected by UNESCO and shared by two countries: Albania and North Macedonia.

The Lake Ohrid watershed (LOW) is part of the extended transboundary Drin River Basin, located in the south-western part of the Balkan Peninsula and shared between Albania, Kosovo[1], Montenegro and North Macedonia. Being EU membership candidates, in 2011 the four countries have signed a Memorandum of Understanding (MoU), creating a Shared Vision for the sustainable management of the Drin Basin. The MoU is an outcome of a Drin Dialogue coordinated by the Global Water Partnership – Mediterranean (GWP-Med) and UNECE. Implementation of the MoU is supported through a process called Drin Coordinated Action (Drin CORDA). An Action Plan has been developed for operationalization of the Drin CORDA, whose implementation is supported by the GEF-funded "Enabling Transboundary Cooperation and Integrated Water Resources Management in the Extended Drin River Basin" Project.

In late 2017 the GWP-Med has initiated activities for development of Lake Ohrid Watershed Management Plan (LOWMP). The initiative is a pilot activity under the GEF Project; its key objectives are to: (1) develop the LOWMP in accordance with the pertaining EU regulations – especially the EU Water Framework Directive (WFD) – and national laws; and (2) test and establish an approach, in the form of ToR for the Extended Drin Basin, for preparation of transboundary management plans for the rivers and lakes of the Drin basin. Further on, the Plan needs to be prepared in a highly participatory manner that will bring together a wide array of decisions makers and other stakeholders from both countries sharing the lake. Therefore, besides putting forward a policy document (Plan) for water resource protection based on a comprehensive planning framework such as the EU WFD, a supplementary goal of the initiative is to showcase a contemporary approach for environmental protection and management of transboundary natural resources and ecosystems in an economically and socially sustainable way.

On the other hand, as widely recognized ecosystems provide people with a flow of benefits, also termed ecosystem goods and services, which directly or indirectly contribute to human well-being. Such goods and services stemming from ecosystems' processes and specifics may come in the form of various material or energy outputs of living systems (e.g. fresh water, food products, timber), but also as merits that result from the pathways in which living systems moderate the environment (e.g. climate regulation, water and air quality, pollination), or even as non-material outputs that people obtain from contacts with ecosystems (e.g. recreational, aesthetic or spiritual experiences). However, given that ecosystem services are not equally distributed in space and do not flow at identical rates, the value of these ecosystem services, as well as of the natural assets that provide them, is often overlooked in a decision-making process. Further, current commodity markets only expose information about the value of ecosystem processes and services that are priced and incorporated in transactions, which thus poses limitations on the ability of the markets to provide a broad picture of the ecological values involved in decision processes. Accordingly, it is largely for these reasons that in the past decades a number of initiatives have been undertaken at the EU and worldwide level that result in creating frameworks aimed at mapping, increasing knowledge base and assessment of ecosystem services. Or, put in other words, the logic behind ecosystem service valuation is to resolve the complexities of socio-ecological relationships, make explicit how human decisions can affect ecosystem service values, and to express these values in monetary units that allow for their incorporation in public decision-making processes.

Hence, the primary objective for conducting an assessment (valuation) of the ecosystem services of the Lake Ohrid watershed and this report is to support the development of the LOWMP. Nevertheless, it is also believed that the findings will provide useful insights suitable for fostering a broader informed debate regarding the definition of regional resource protection policies, as well as for promotion and coordination of more detailed further ecosystem service valuations, which are regarded as basic component of an adaptive multi-level and

[1] * References to Kosovo shall be understood to be in the context of Security Council Resolution 1244 (1999).

long-term environmental governance, in both countries. In this respect, it is also believed that the valuation of the LOW ecosystem services as presented herein will serve as a baseline for future valuations of the natural capital of Lake Ohrid and the benefits it contributes to well-being of the societies.

The report provides: (1) a brief overview of LOW natural and socio-economic conditions and its natural and cultural resources; (2) an indication of the perception of Lake Ohrid's values by the key environmental resource users (local residents and tourists); and (3) valuation of watershed's ecosystem services along with summary results and conclusions.

The data used in this analysis include background information and questionnaire data. The background information refer mainly to statistical and other data used for development of the LOWMP. The questionnaire data derive from a survey that was conducted in the LOW region in the summer/autumn of 2018, with an objective to gather an insight into the end-users' perception of the values and benefits arising from the natural characteristics of the LOW, the awareness of the pressures impacting the status and quality of basin's water resources, as well as to determine their willingness-to-pay for improved protection and overall conditions in the LOW.

The findings of the analysis are presented in Chapters 2 to 5 of this report. Supporting information is provided in the Annexes. Graphical presentation of key socio-economic data and ratios are presented in Thematic GIS-based Maps. Technical information is presented in metric units and the costs are in US$ or Euro.

2. The Lake Ohrid Watershed

2.1. Natural Conditions

Topography

With a maximum depth of 290 meters and average depth of 155 meters, straddled in the mountainous region between the southwestern part of North Macedonia and the eastern part of Albania, Lake Ohrid is one of the oldest and deepest lakes in Europe. The lake is located at an altitude of 693 masl and has an area of 358 km^2. The hydrological regime of the lake is dominated by inflow of water from the nearby Lake Prespa via karstic aquifers, while the outflow occurs through the Black Drin river in the town of Struga.

The Lake Ohrid watershed is part of the extended transboundary Drin River Basin, located in the south-western part of the Balkan Peninsula and shared between Albania, Kosovo, Montenegro and North Macedonia.

Fig. 2.1 Lake Ohrid Watershed, key characteristics

Indicator	
Watershed area (km^2)	1,404.9
Lake total area (km^2)	357.9
Watershed/Lake area ratio	2.9
Maximum elevation (masl)	2,271
Average watershed elevation (masl)	1,139
Minimum elevation (Lake Ohrid, masl)	693.1
Lake water level control (Yes/No)	Yes
Average water level change (m)	0.8
Average lake depth (m)	155
Maximum lake depth (m)	293
Lake volume (km^3)	58.6
Dynamic ratio (km/m)	0.6
Retention time (Years)	70- 80
Shoreline length (km)	87.5
Trophic classification	Oligotrophic

Climate, hydrology and hydrography

In general, the local climate conditions in the LOW are categorized as Mediterranean with continental influences. The local climate is influenced by the proximity to the Adriatic Sea, by the surrounding mountains, and by the thermal capacity of Lake Ohrid.

The mean annual temperature recorded in the Ohrid region averages at 11.5 °C; average temperatures range from 21°C during summer to 1.8°C during winter. The temperature of Lake Ohrid's pelagic water (below 150 m depth, year-round) ranges from 6°C to 24–27°C at the surface during summer.

The morphology of the basin also affects the wind regime, with northerly winds prevailing during winter and southerly and southeasterly winds during spring and summer. Average speed of the wind in the Lake Ohrid region is relatively low at 1.8 m/sec.

Precipitation averages around 750 mm annually and is at a minimum during summer. On annual basis, precipitation and lake water-level oscillation reach their peak values (maximum and minimum) in different seasons. Maximum precipitation occurs in the form of snowfall in November/ December, when the lake's water levels are at their lowest. The snow remains throughout the winter at high altitudes (above 1,000 masl.), but begins melting and entering the lake in March/April which then reaches its maximum water level in May/June.

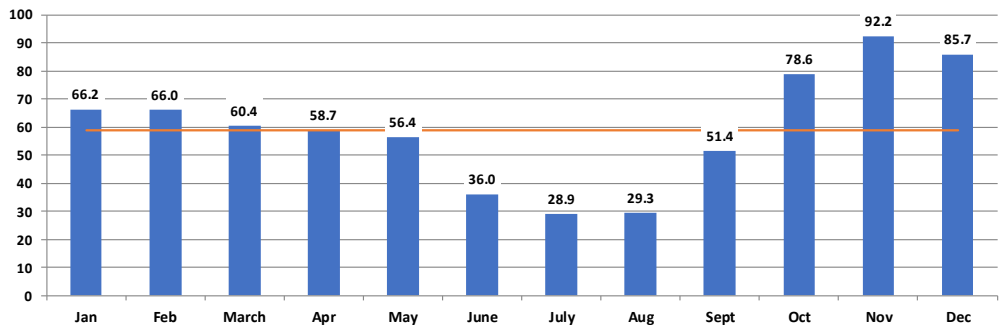


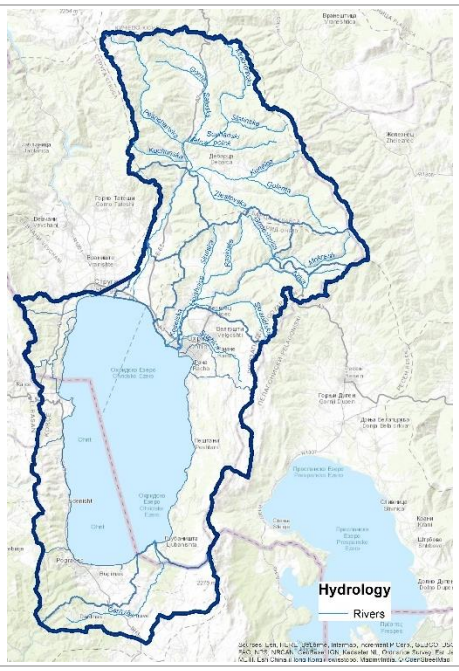
Fig. 2.2: Average monthly precipitation

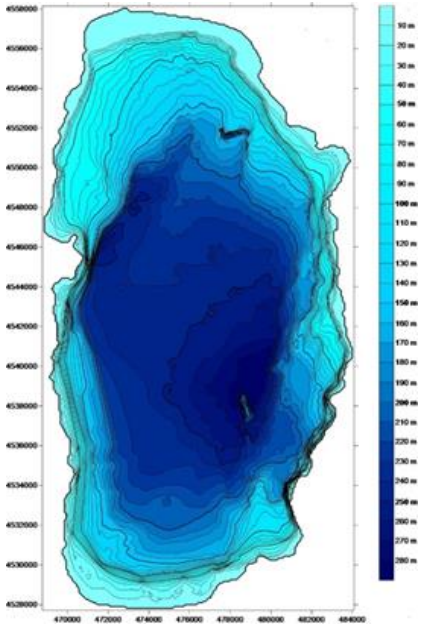
MS Ohrid, 1961 - 2016

The hypothesis that the water from the nearby Prespa Lake is seeping into the karst massif of the Galichica and Suva Gora mountains and draining into Ohrid Lake was first published by Cvijić (1906). The validity of the hypothesis was proven with isotope-based tests (Anovski et al. 1997, 2001; Eftimi and Zoto 1997). Much of the karstic type of aquifers are found in the triennial limestones of Galichica and Jablanica, which drain through numerous springs into Lake Ohrid. Estimates imply that 49% of the inflow from springs into the lake comes from sublacustrine (under water) springs and 51% from surface springs. The most important are: St. Naum (5-10 m^3/sec), Tushemisht (2.5 m^3/sec), Biljanini Springs (1-2 m^3/sec), Bej Bunar (40-100 l/s), and other unknown number of sublacustrine springs.

Besides the springs, important volume of water drains in Lake Ohrid through a number of tributaries, most of which are small creeks that flow only temporarily during snowmelt and heavy rain periods. The main rivers in the LOW, tributaries to Lake Ohrid (Fig. 2.3), include: Sateska, Koselska, Shushica and Grashnica river in North Macedonia, as well as Çeravë and Verdovë rivers in Albania. Two-thirds of the LOW (Lake Ohrid) water outflow passes into the Black Drin River at the town of Struga, flowing northwards on the way to the estuary in the Adriatic Sea. The remaining one-third of the lake's water is lost through evaporation (Watzin et al. 2002).[2] Since 1962 the river's outflow has been controlled with a weir, which regulates the water level in the lake.

Fig. 2.3: Tributaries and bathymetric map of Lake Ohrid





Land cover

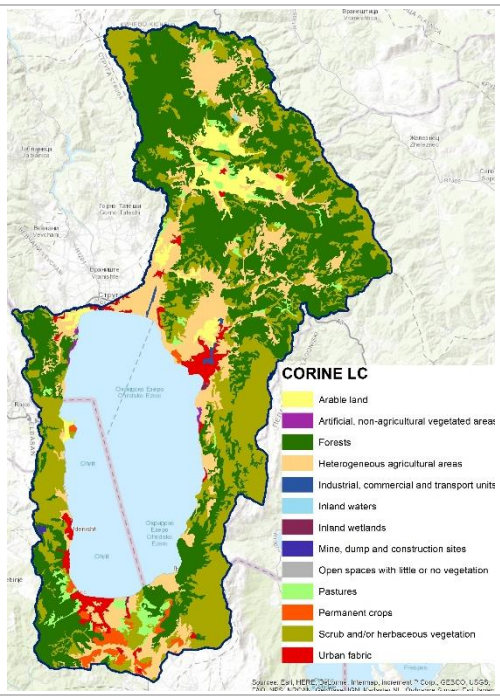
The land cover/land use analysis of the LOW is based on data from the European Environment Agency's CORINE

[2] Source: "Shorezone Functionality, Ohrid Lake"; Implementing the EU Water Framework Directive in South-Eastern Europe. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (2017).

Programme[3] (Fig. 2.4). The surface area of the LOW is dominated by Forests, Scrub and open spaces, and the surface area of Lake Ohrid, which collectively account for 79% of the total basin area. Other dominating land cover classes are Arable land and Heterogeneous agricultural areas, which make up 15.6% of the area. Of the remaining 5.3% of land, dominant classes are Urban fabric (2%) and Pastures (1.9%).

Fig. 2.4: LOW Land cover (CORINE Level 2 LUC)

CORINE Land Classes	Area (km2)	% of total
Arable land	43.0	3.06%
Artificial, non-agri. vegetated areas	1.4	0.10%
Forests	457.5	32.58%
Heterogeneous agricultural areas	176.1	12.54%
Industrial, comm. and transport units	2.0	0.14%
Inland waters	2.0	0.14%
Inland wetlands	0.7	0.05%
Mine, dump and construction sites	0.6	0.04%
Open spaces with little or no vegetation	0.4	0.03%
Pastures	26.0	1.85%
Permanent crops	15.1	1.07%
Scrub and/or herbaceous vegetation	294.8	20.99%
Urban fabric	27.6	1.96%
Lake area	357.0	25.43%
Total LOW	**1,404.0**	



Protected areas

A total of 9 protected and sensitive areas located in the LOW are identified, that fall into four of the six IUCN[4] categories (Table 2.1). The total area of all protected areas equals 661.6 km^2 (47% of the total basin area), of which 268.4 km^2 in Albania and 393.2 km^2 in North Macedonia.

Table 2.1: LOW: Protected Areas[5]

ISO3	Site Name	Year	Designation	IUCN CAT	Area (km^2)
MKD	Galichica	1958	National Park	II	145.9
MKD	Ohridsko Ezero	1977	Designated area not yet reviewed	III	247.4
MKD	Duvalo (Kosel)	1979	Designated area not yet reviewed	III	0.0
MKD	Makedonski dab, s.Trpejca, Ohrid	1967	Designated area not yet reviewed	III	0.0
MKD	Platan s.Kalishte, Struga	1961	Designated area not yet reviewed	III	0.0
MKD	Platan-chinar, Ohrid	1967	Designated area not yet reviewed	III	0.0
ALB	Shebenik-Jabllanice	2008	National Park (category II)	II	0.6
MKD	Platanovi Stebla, Ohrid	1967	Designated area not yet reviewed	III	0.0
ALB	Liqeni I Ulzes	2013	Managed Nature Reserve (category IV IUCN)	IV	267.8
				Total	**661.6**

2.2. Socio-economic Conditions

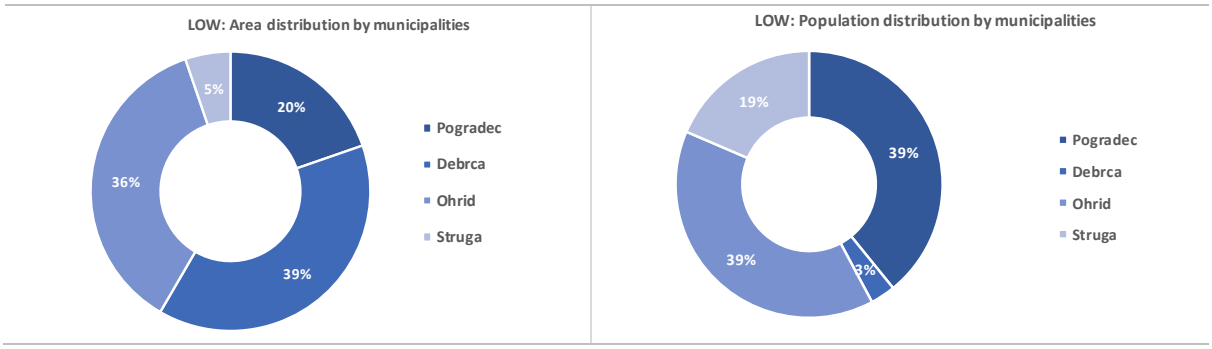
Administrative division

The transboundary LOW is shared between Albania (313 km^2 or 22% of the total basin territory) and North

[3] European Environment Agency (EEA), CORINE (Coordination of information on the environment).
[4] IUCN – International Union for Conservation of Nature.
[5] Source: European Environment Agency's (EEA), The European inventory of nationally designated areas holds information about protected areas and the national legislative instruments, which directly or indirectly create protected areas.

Macedonia (1,091 km^2; 78% of the territory). Administratively, the watershed area falls under four municipalities (local government units), of which Pogradec municipality is in Albania, while Ohrid, Struga and Debrca municipalities are in North Macedonia. The distribution of the LOW territory by the four municipalities is shown on Fig. 2.5. In reference to the administrative division of the basin territory by municipalities, it should be pointed out that only 34% of Pogradec, 98% and 95% of Ohrid and Debrca respectively, and merely 11% of the total area of Struga municipality falls within the LOW. Following the territorial division of Albania from 2014/15, the Albanian territory of the LOW falls under five Administrative Units: Buçimas, Çeravë, Dardhas, Pogradec and Hudenisht.

Fig. 2.5 LOW: Area and population distribution by municipalities



Demography and housing

The total population of the LOW equals 132,059 divided nearly equally between female and male population. Of the total, 39% live in Pogradec municipality, 3% in Debrca, 39% in Ohrid and 19% in Struga (Table 2.2). The overall density of the population for the LOW as a whole is 126 persons per square kilometer.

Table 2.2: LOW: Population statistics

Municipality	Female	Male	Total Municipality	Year	% of LOW population	Area (km^2)	Population density (cap/km^2)	% Urban	% Rural
Pogradec	25,341	26,375	51,716	2011	**39%**	206.2	251	14%	86%
Debrca	2,005	1,989	3,994	2015	**3%**	405.0	10	0%	100%
Ohrid	26,183	25,668	51,850	2015	**39%**	381.0	136	75%	25%
Struga	12,285	12,214	24,498	2015	**19%**	54.8	447	71%	29%
TOTAL in LOW	**65,813**	**66,245**	**132,059**		**100%**	**1,047.0**	**126**	**48%**	**52%**

The total number of settlements in the basin is 94, of which 25 (26.6%) in Albania (Pogradec municipality) and 69 (73.4%) in North Macedonia. 53 of the 94 settlements (or 56%) have population of less than 500, and only 5 have population bigger than 2,000. 58% of the total population in the LOW lives in the three largest cities (municipal administrative centers): Pogradec, Ohrid and Struga.

GDP and employment

According to national statistics, the GDP per capita in 2018 was $5,239 in Albania and $6,100 in North Macedonia. Statistical data for both countries show relatively steady upward growth in these figures over the last several years.

As regards employment, statistics are kept differently in each country but it is clear that unemployment and/or underemployment is high in both countries. In Albania, according to data compiled by the Albanian Institute of Statistics, in 2016 the unemployment rate equaled 15.2%; in North Macedonia, according to the State Statistical Office (SSO), the same rate equaled 23.7%. The situation is considered even more difficult if market indicators are segregated by gender. Thus, the inactivity rate (proportion of the population that is not in the labor force) in 2015 in Albania equaled 52.7% for female population and 35.7% for male population, whereas in North Macedonia the same rate for the female population equaled 55% and 30.8% for male population.

2.3. Natural Resources

Lake Ohrid itself is formed over one graben structure with meridian orientation and horizontal pulling along the main tectonic separator bend: Bilisht – Korçe – Diber. The general extent of the lake is limited by the horst of Suva Mountain (in the east) and Mokra Mountain (in the west). The form of the lake and its shoreline (simple and straight) have been shaped by neotectonic movements along faults that remain active today. Movement along these faults is experienced as earthquakes. The LOW belongs to the Western Macedonian geotectonic zone, which represents a segment of the interior Dinaric Alps. The bedrock structure of the watershed area includes rock masses of various types, composition and age, going all the way back to the Paleozoic, Mesozoic and Cenozoic Eras.

With an estimated age of 2–5 million years, Lake Ohrid is the oldest lake in Europe. Although more work is needed to determine the hypothesis of the lake's origin and age, it remains undisputed that the lake has persisted in its present form since at least the Pleistocene [20]. Four hypotheses exist regarding the limnological origin of the lake, but two of them seem most accurate: the first one supports the theory of "de novo" formation of Lake Ohrid in a dry polje with a spring or river hydrography; and the second hypothesis presumes a paleogeographic connection of Lake Ohrid with the brackish waters on the Balkan Peninsula [21].

The oligotrophic Lake Ohrid is phosphorus limited [2], with an average total phosphorus concentration of 4.5 mg/m^3 and total nitrogen concentration of 171–512 mg/m^3 [22]. The lake's silica concentration is < 200 mg/m^3 in the trophogenic zone during summer, while the average water pH and conductivity are 8.48 and 208 µS/cm respectively. The average Secchi depth is roughly 14 m. Although the concentrations of phosphorus and the water transparency measured in the last few years still suggest an oligotrophic condition in Lake Ohrid, the living organisms show a different pattern. Both the phytoplankton and zooplankton communities are shifting to species composition more characteristic of a mesotrophic lake [23].

Compared with other ancient lakes, Lake Ohrid is relatively small with a total surface area of 358 km^2 and a maximum depth of 293m. Despite its size, the lake contains considerable aquatic species diversity and endemism. Of the 1,200 animal species reported, 212 are considered endemic [21]. Ten of the seventeen identified fish species of the Lake Ohrid are endemic, as are many of the lake's snails, worms, and sponges. According to published data based on almost a decade of detailed taxonomic work on the lake, in total 789 diatom taxa have been recorded, including 117 endemic species [24]. Harboring more than 300 endemic species, Lake Ohrid has the highest index of endemism of all ancient lakes.

The reed belt along the coastline of the lake serves as a spawning site for many fish species and an important wintering site for birds. Tens of thousands of birds of more than twenty species populate the area. However, development has also changed the natural habitats along the shoreline, especially in the areas around Ohrid, Struga, Peshtani, St. Naum, Tushemisht, and Pogradec. In these areas the native reed zone has been drastically reduced, and nutrient enrichment has stimulated the growth of new aquatic plants. The changes in shoreline vegetation have also interrupted the connections between the lake and the shoreline channels and wetlands.

Additionally, the commercially important fish species in Lake Ohrid, including its famous Lake Ohrid trout, have been harvested at unsustainable levels in recent years and the populations of trout are in immediate danger of collapse. Human activities along the shoreline also threaten the spawning and wintering grounds of the Ohrid trout and other fishes [25, 26].

Apart from the lake, as indicated before 47% (662 km^2) of the total watershed territory (1,404 km^2) falls under protected areas that represent additional precious natural asset of the region. Further, 32.6% of the territory is under Forests, 21% under the CORINE LUC of Scrub and open spaces and 15.6% under the categories of Arable land and Heterogenous agricultural areas.

2.4. Cultural Heritage and Resources

The World Heritage Committee of UNESCO inscribed the North Macedonia part of Lake Ohrid on the World Heritage List under natural criteria in 1979. In 1980 the property has been extended to include the cultural and historic area, and three additional criteria had been added. In July 2019 the site has been extended to include

the north-western part of Lake Ohrid in Albania, the Lin Peninsula and a strip of land along lake's shoreline connecting the peninsula with the North Macedonia border[6]. The entire territory of the protected site represents a category of cultural landscape in which history, cultural tradition and societal values are inseparable.

Region's cultural and ambient characteristics hold multilayered values of Lake Ohrid and the surrounding mountain ranges. The universal values of the region are nested in the centuries long synthesis of an iconic nature and human-made structures. Using the lake as a primary source of life, numerous generations have left links between nature, rural and urban living. Thus, the Lake Ohrid region has homed humanity for thousands of years, dating back to the Tertiary period. Remains of Neolithic settlements are found around the lake, with further inhabitance by Illyrian and Hellenic tribes confirmed by ancient scripts, the still standing Ancient theatre of Ohrid and the Monumental Tombs of Lower Selca.

As the history of the region developed, so did the appearance and life in the settlements around the lake. The remains of Via Egnatia, the ancient Roman road connecting Rome and Byzantium (present day Istanbul) in near vicinity of the lake are proof of the civilization continuum throughout the era before Christ. Various early roman Basilicas and mosaics, such as the ones in Lin, St. Erasmo and Plaoshnik, account for the early adoption of Christianity in the region. The 6th century paleochristian church of Lin's floor mosaics spreading over 120m^2 are remarkably conserved and have an outstanding artistic value [11].

As the Slavic tribes began to settle in the region and adopted Christianity, the region became a cradle of Christian theology. Various saints practiced and spread Christianity around the lake, amongst which St. Clement of Ohrid is the most important. Nowadays a newly reconstructed Church sits where St. Clement himself reconstructed an old Church with the purpose of spreading Christianity amongst Slavs. He founded the Ohrid Literacy School, where the Bible was taught in Old Church Slavonic with the use of the Cyrillic script, which he helped develop. His tomb rests in the church to this day.

In the middle ages the region became part of Tsar Samuil's empire, with the city of Ohrid serving as the capital. The fortress built for his needs, with findings of ancient Greek scripts suggesting that it was originally built in the 4th century B.C., was later used by the Ottoman empire and it proudly sits on the highest point of the city to this day.

On top of a hill in Pogradec there are remains of an Illyrian-Albanian castle in a site that has been populated since the 6th century B.C. The churches of St. Sophia and Kaneo in the city of Ohrid from the 11th and 13th century respectively are prime examples of Byzantine architecture that attract plenty of tourists, host cultural events, etc. The St. Jovan Kaneo church, resting on a cliff right above the lake in the city of Ohrid, blends marvelously with the natural setting of the region. The St. Naum monastery from the 16th century on the other side also sits on a plateau right above the lake and has historically welcomed both Christians and Muslims from the region.

Apart from the Byzantine, today's architecture of the area is mostly from the times of the Ottoman Empire. The narrow cobblestoned streets, numerous mosques and churches, tightly built two to three story buildings throughout the lakeside cities of Ohrid and Pogradec are what gives them a particular charm.

A list of 40 major cultural heritage sites of the North Macedonia part of the LOW are shown in Appendix 4.

Lake Ohrid, besides being a natural phenomenon, for centuries has also been an important source of food for the local population. As a consequence, there are a number of fishermen settlements along the shoreline. The fertile valleys located among region's mountain ranges have created conditions thoroughout the centuries for development of numerous rural settlement with distinct architecture and appeal, all of which also represent a piece of the overall cultural heritage and value of the entire watershed, thus attracting particular attention of visitors.

[6] Source: https://whc.unesco.org/en/list/99/.

3. Perception of the Natural and Cultural Values of the Lake Ohrid Region

The wider Lake Ohrid territory, with all its grandiose appearance and biodiversity values has an undeniable natural and cultural significance, as confirmed by the number of visitors to the region and by its UNESCO World Heritage Site status. However, it cannot be taken for granted that the residents and tourists in direct contact with the area itself are fully aware of its importance, and even more so of its innate vulnerability and required level of protection.

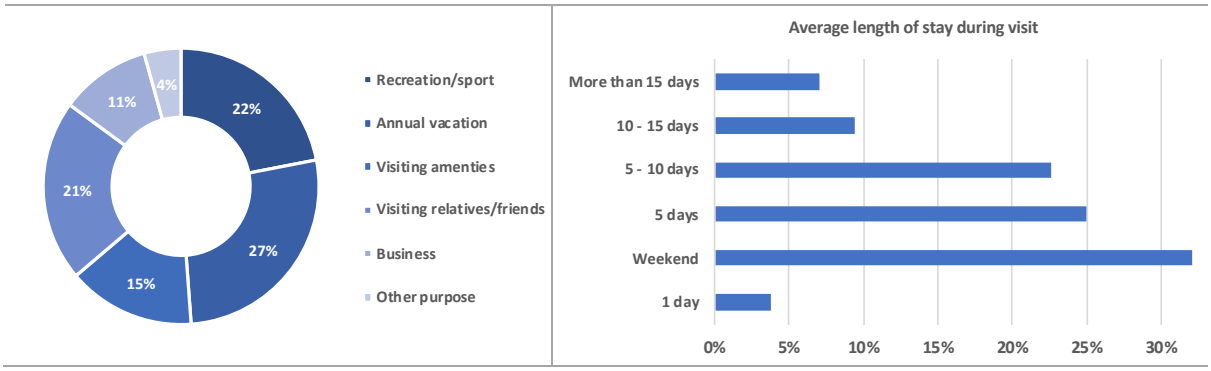
Therefore, in order to elicit the opinion and awareness of the general public and the local community regarding these aspects, as part of the survey conducted for the ecosystem valuation effort a set of questions were included in the survey questionnaires that are focused primarily on the perception of the region's values, as well as on the observations relating to the existence of potential impacts that might hamper the values. Overview of the answers gathered with that part of the survey are provided further.

The survey was conducted in August/September 2018 and covered 220 residents of the LOW and 212 tourists, both domestic and foreign. Two questionnaires were developed for the purpose (Appendix 3). The survey covered all administrative units within the Pogradec municipality and the three municipalities of North Macedonia. It was carried out as 'direct interview with respondents' type of survey by a group of selected local residents (surveyors) from Pogradec, Ohrid and Struga. The surveyors were consulted on various aspects of the task and coordinated during the survey implementation. The choice of respondents was random, however special attention was given to equal participation of female and male respondents.

Reasons for visiting the region and length of stay

The main reason tourists visit the Ohrid Lake is annual vacation, closely followed by recreation/sport and to visit relatives/friends (Fig. 3.1). Majority stay for 2-3 days (32.1%), suggesting that the Lake Ohrid region is predominantly a weekend destination. Nevertheless, there is also a significant percentage of the respondents (visitors) that stay for 5 days (25%) or more (22.6% stay 5-10 days) (Fig. 3.1).

Fig. 3.1: Main reasons for visiting Lake Ohrid and average length of stay



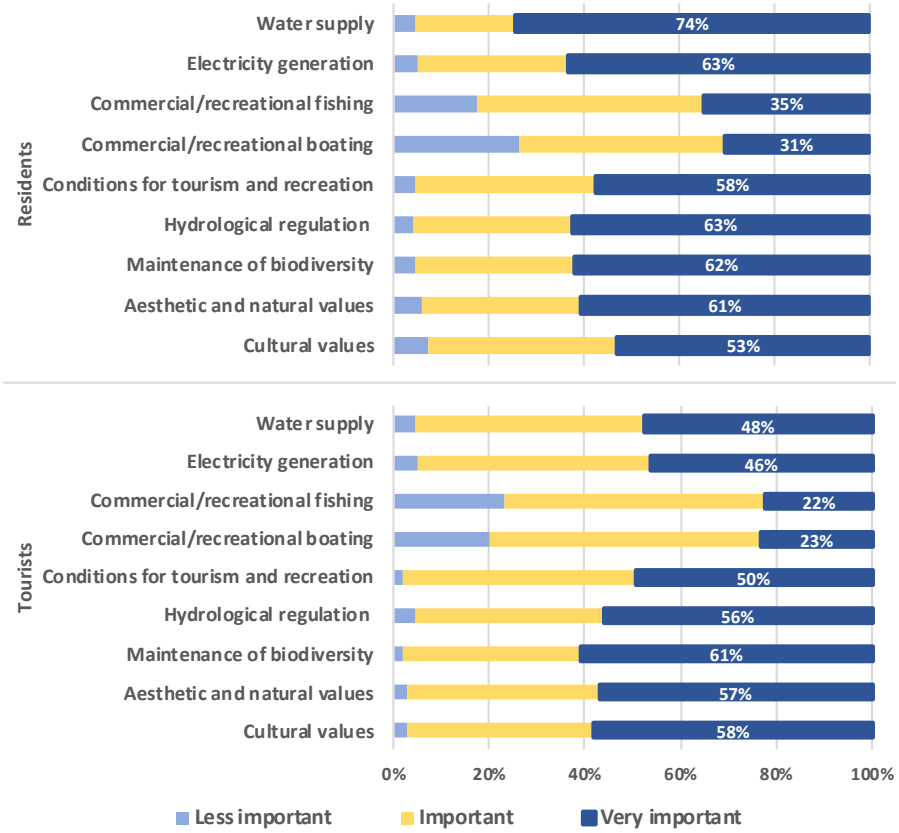
Perception of the benefits (ecosystem services) of the LOW

When asked to rank the importance of the benefits that people have from the Lake Ohrid watershed, tourists and residents had similar opinion (Fig. 3.2). Water supply and maintenance of biodiversity are the two highest ranked benefits in the eyes of residents and tourists respectively. While biodiversity maintenance is equally important for both residents and tourists, the water supplied by the Lake Ohrid is perceived as more important by residents compared to tourists. 74% of questioned residents view water supply as very important, while 48% of tourists have the same opinion.

The benefits of cultural and natural values also have a high importance in the tourists' opinion, along with hydrological regulation. On the other hand, fishing and boating are not perceived as very important benefits provided by Lake Ohrid. Electricity generation, like water supply is a service that is much more valued by the

residents than the tourists, as residents are more likely to be aware of the importance of the Ohrid Lake in the downstream electricity production compared to tourists.

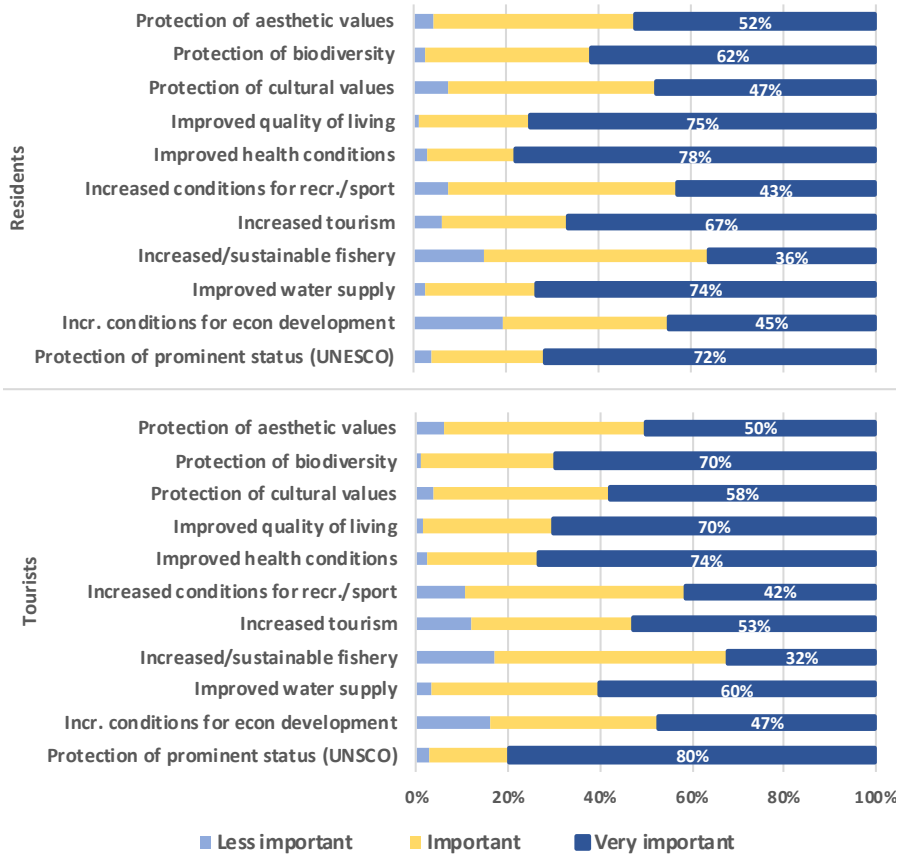
Fig. 3.2: Benefits provided by the Lake Ohrid watershed



Perception of the benefits linked with good water quality

When asked about benefits closely linked with the water resource quality in the basin, the protection of the UNESCO World Heritage Site status has a very high importance amongst both tourists and residents (Fig. 3.3). As already stated, it can be concluded from the chart that tourists give higher importance on cultural values and biodiversity protection, compared to residents who place high importance on water supply. Nevertheless, improved quality of living and health conditions are benefits from good water quality that both tourists and residents value highly. Increased conditions for economic development and increased/sustainable fishery are benefits that are seen as least important by both groups of respondents.

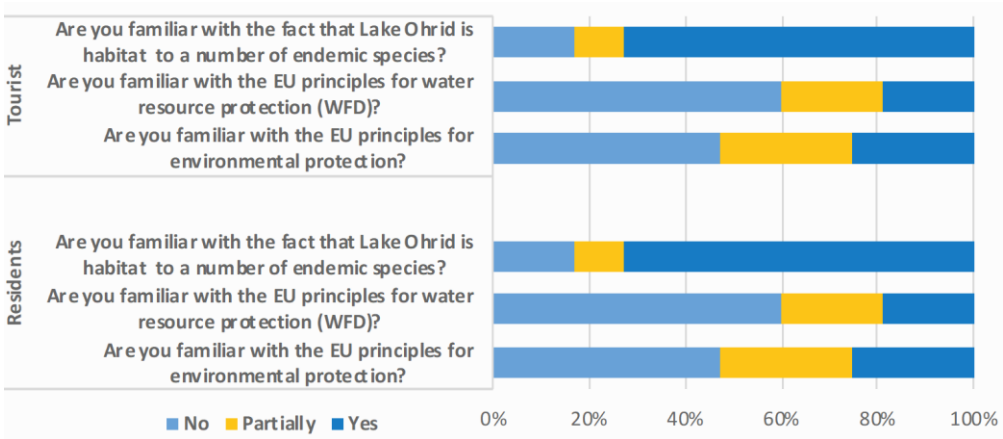
Fig. 3.3: Benefits linked with good water quality



Awareness of Lake's endemism and EU environmental protection principles

Even though the public is generally aware of the benefits provided by the Lake Ohrid and its watershed, it has a low awareness of existing environmental (especially water resource) protection standards and principles (Fig. 3.4).

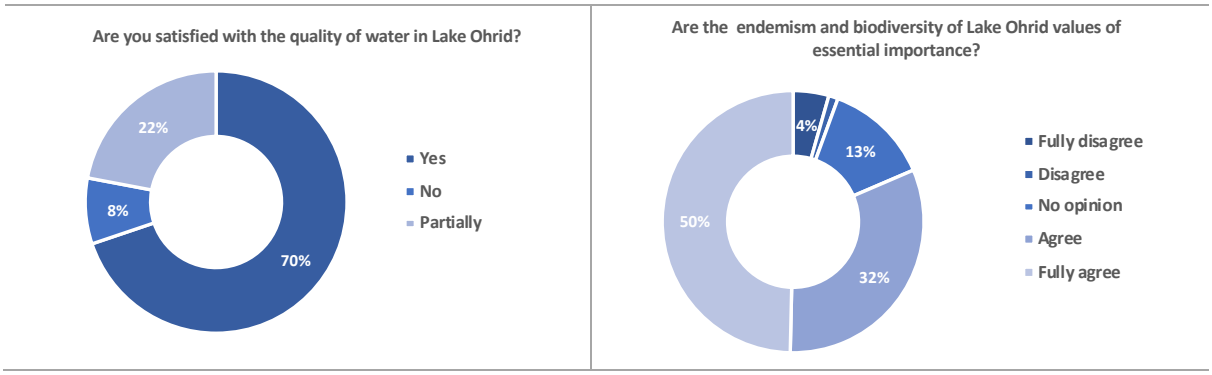
Fig. 3.4: Awareness of Ohrid Lake endemism and knowledge of EU environmental protection principles



Satisfaction with Lake's water quality

The high awareness regarding biodiversity and endemism of Lake Ohrid (Fig. 3.5), coupled with the UNESCO status and limited knowledge of environmental standards (Fig. 3.4) may lead towards an opinion that human impact on the watershed is negligible. In fact, only 8% of the questioned are dissatisfied with the Lake Ohrid water quality (Fig. 3.5).

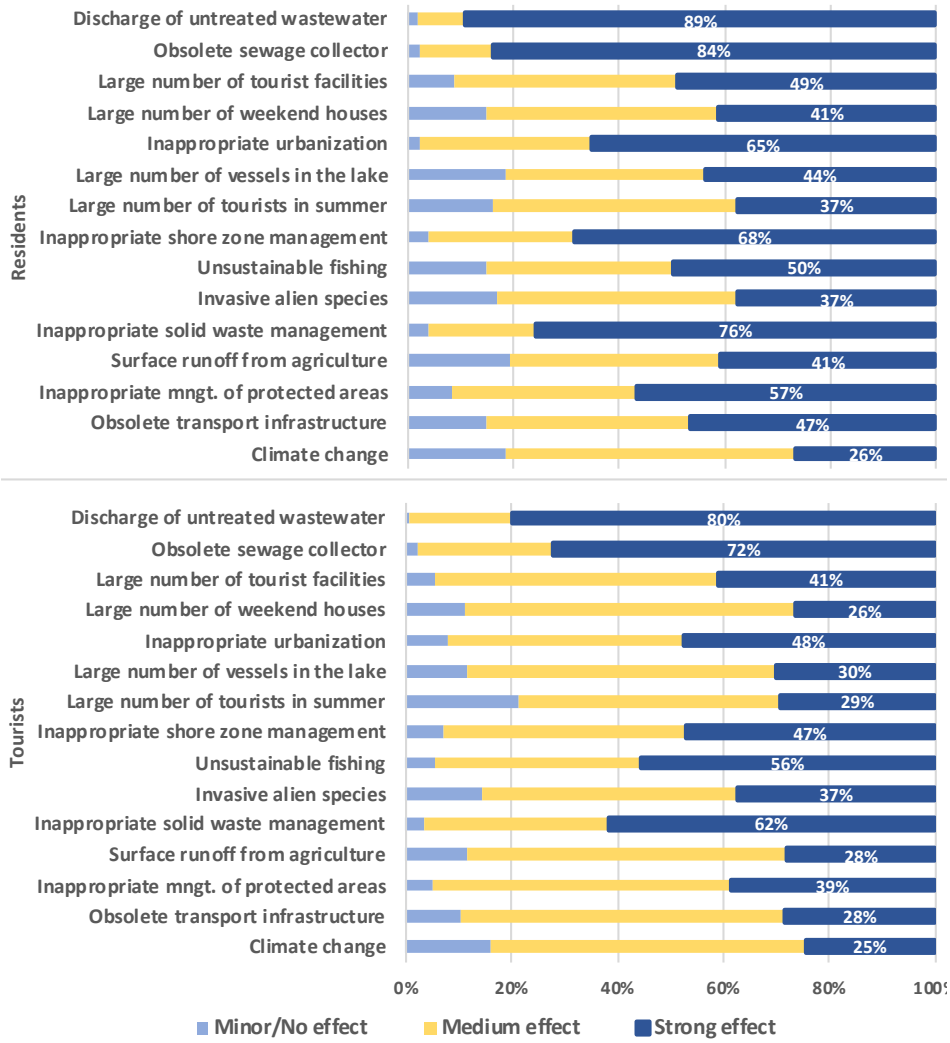
Fig. 3.5: Satisfaction with water quality and importance of biodiversity and endemism in Lake Ohrid



Awareness about pressures on water quality and biodiversity

In terms of the perceived pressures on the water quality and the biodiversity in the Lake Ohrid watershed, the main concern for the public (residents and tourists) is the discharge of untreated wastewater (sewage) into the lake (Fig. 3.6), with 89% of residents and 80% of tourists believing that it has a strong negative effect on the water quality and biodiversity. Furthermore, the obsolete sewage system is believed to be a strong effect as well, which goes hand in hand with the discharge of untreated wastewater.

Fig. 3.6: Ranking of pressures on water quality and biodiversity in Lake Ohrid



Solid waste mismanagement is the next pressure believed to have a strong negative effect. Inappropriate shore zone management is a pressure that is differently perceived by locals and tourists, i.e. locals are much more aware of the mismanagement of the Lake Ohrid shore zone, along with inappropriate urbanization.

Although the general trend is the same between locals and tourists, local residents assign greater importance on all but one pressure out of those listed in the questionnaire. Apart from the ones already mentioned, the difference is particularly visible for pressures such as "large number of weekend houses", "large number of tourist facilities", "obsolete transport infrastructure", all of which are related to urban planning and infrastructure. Additionally, around 56% of the local population believe that inappropriate management of protected areas has a strong effect on the watershed biodiversity, while only around 39% of the tourists believe the same.

Benefits from protection of water quality

All benefits mentioned so far are to be enjoyed by a number of different stakeholders. Tourists and residents have practically equal opinion regarding which shareholders would benefit the most from a good water quality. Largest part believe that the local population would benefit the most, closely followed by tourist facilities, businesses and lastly the local industry (Fig. 3.7).

Fig. 3.7: Stakeholders benefits from maintenance of good water quality in Lake Ohrid (residents & tourists)

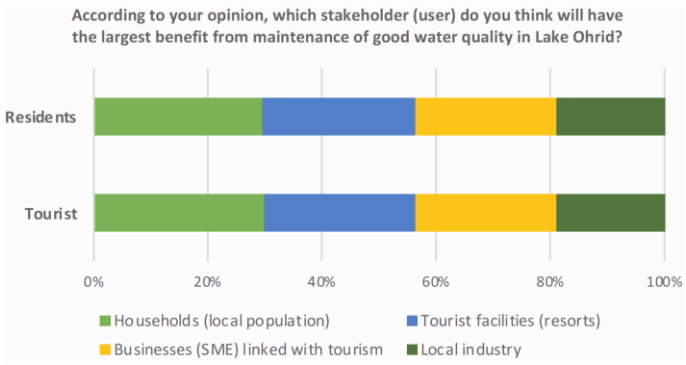
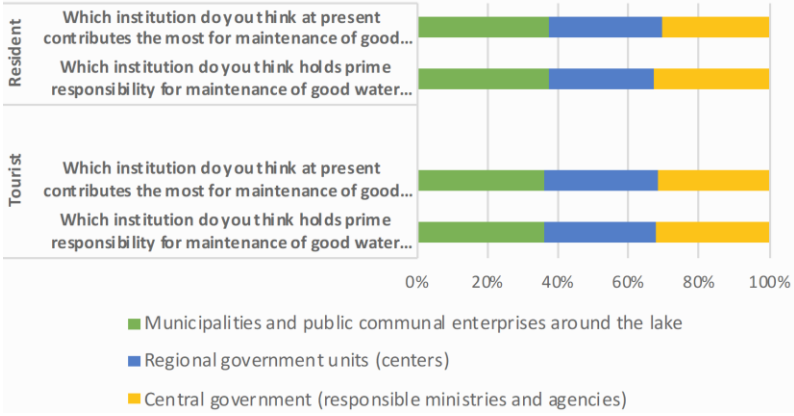


Fig. 3.8 presents the views regarding which institutions hold prime responsibility for maintenance of good water quality in the lake. The municipalities and public enterprises around the lake are seen as the most responsible and also the ones contributing the most towards maintenance. Regional centers and central government ministries are perceived as less responsible and less contributive, both with around 30-32% shares respectively.

Fig. 3.8: Contribution and responsibility for maintenance of good water quality in Lake Ohrid



4. Valuation of the Ecosystem Services of the Lake Ohrid Watershed

4.1. Valuing Natural Capital Principles

Ecosystem services, sometimes also called ecosystem benefits, are most broadly defined as the direct and indirect contributions of ecosystems to human well-being. The term Natural capital is described as the Earth's natural assets (e.g. soil, air, water, flora and fauna) and the ecosystem services resulting from them [1]. The origins of the concept of ecosystem services date back to the 1980-ties (e.g. [2, 3]), however, it has been widely popularized by the UN Millennium Ecosystem Assessment (MEA) in the early 2000s [4]. Further, ecosystem services approach is central to the EU's biodiversity strategy, presented by the European Commission (EC) in 2011 with the aim to stop their degradation in the EU by 2020 and to protect, value and restore biodiversity and the ecosystem services it provides by 2050 [1].

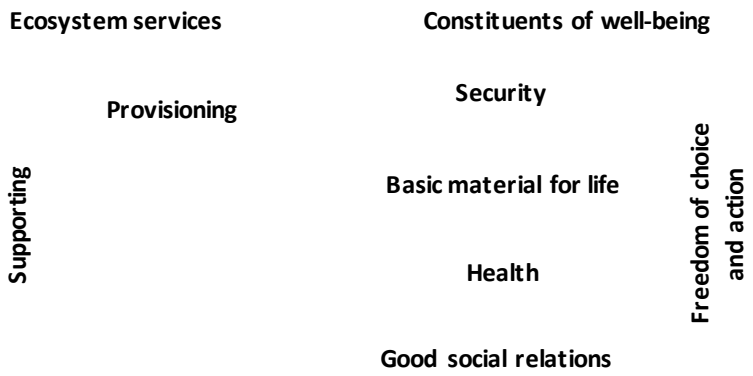
Regardless of the origin of the ecosystem services concept and their definition, when considering the links between nature, economic activities and human welfare clearly both quantity and quality attributes of biodiversity are important. Therefore, the extent of the analyzed ecosystems (e.g. forests or water resources), as well as the abundance of habitats and the specifics of the individual plants and animals within the ecosystems, are the critical components of natural capital shaping the multitude of delivered benefits, thus also determining the flow of values to human societies (Fig. 4.1).

One overarching question frequently found in a number of publications is why is there a need to value ecosystem services? A comprehensive answer to this question includes: “Economics is about choice and every decision is preceded by a weighing of values among different alternatives. Ecological life support systems underpin a wide variety of ecosystem services that are essential for economic performance and human well-being. Current markets, however, only shed information about the value of a small subset of ecosystem processes and components that are priced and incorporated in transactions as commodities or services, which poses structural limitations on the ability of markets to provide comprehensive pictures of the ecological values involved in decision processes. Moreover, an information failure arises from the difficulty of quantifying most ecosystem services in terms that are comparable with services from human-made assets. From this perspective, the logic behind ecosystem valuation is to unravel the complexities of socio-ecological relationships, make explicit how human decisions would affect ecosystem service values, and to express these value changes in units (e.g., monetary) that allow for their incorporation in public decision-making processes” [6]. Further, linking biophysical aspects of ecosystems with human benefits through the notion of ecosystem services is essential to assess the trade-offs (ecological, socio-cultural, economic and monetary) involved in the loss of ecosystems and biodiversity in a clear and consistent manner [7]. Thus, valuation of ecosystem services is not seen as an end in itself, but rather it is meant to provide a framework for better-informed decision-making and policy development.

The economic valuation of ecosystem services is based primarily on classification of these services and application of different methods to calculate (monetize) their values. In that respect, the MEA defines and divides ecosystem services into four broad categories:

- **Provisioning services** – food, fiber, timber, energy – i.e. all nutritional, non-nutritional material and energy outputs from living systems
- **Regulating services** – e.g. climate regulation, pollination, water purification, river flow – i.e. the ways in which living organisms mediate or moderate the ambient environment
- **Cultural services** – such as recreational, spiritual, aesthetic, educational – i.e. all non-material, non-consumptive outputs (benefits) that people obtain from contact with ecosystems
- **Supporting services** – soil formation, photosynthesis, nutrient cycling – ecosystems’ specifics (processes) that provide living spaces for plants or animals, or help the maintenance of the diversity of plants and animals.

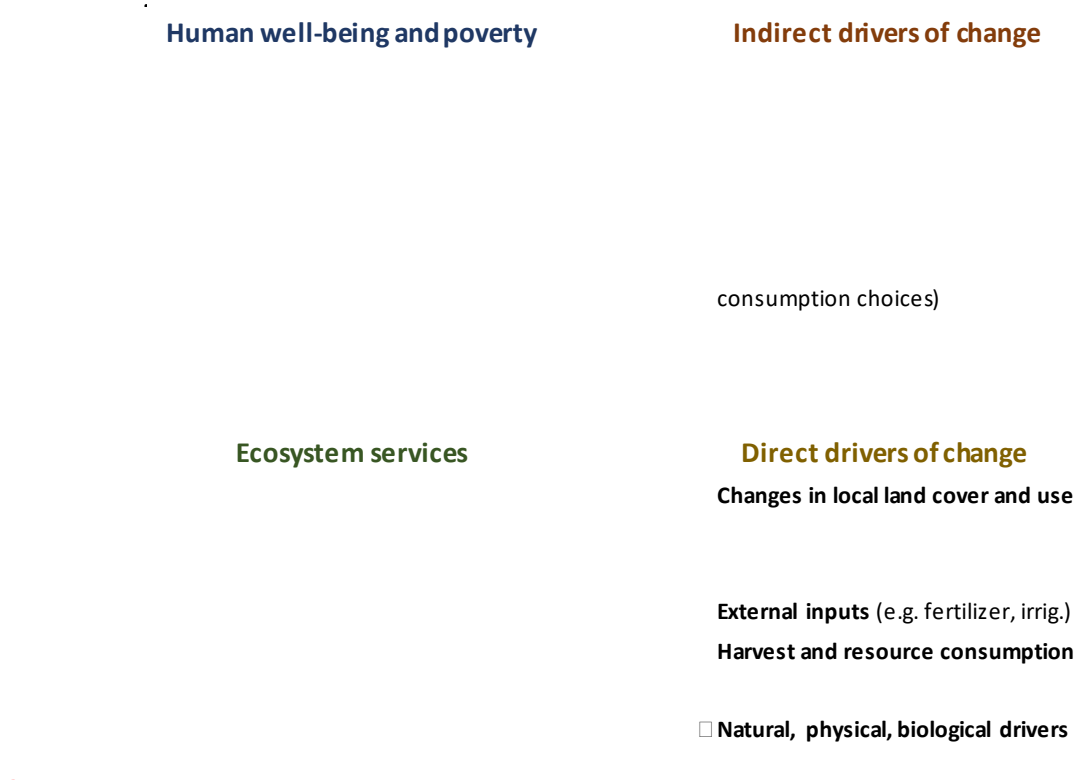
Fig. 4.1: Links between ecosystem services and human well-being[7]



Arrow's width shows the intensity of linkages

In addition to analyzing the links between ecosystem services and human well-being (Fig 4.1), the MEA also focuses on the dynamic interactions between humans and ecosystems by examining how changes in ecosystem services influence the constituents of well-being, as well as how changes in human conditions drive – directly and indirectly – changes in ecosystems (Fig 4.2). Thus, changes in drivers that indirectly affect biodiversity (e.g. population, technology) can lead to changes in drivers directly affecting biodiversity (e.g. changes in land-use or application of fertilizers), which result in changes to ecosystems and the services they provide, thereby affecting human well-being. Further, these interactions can take place at more than one scale and can cross scales.

Fig. 4.2: Interactions between ecosystem services, human well-being and drivers of change[8]



Apart from the MEA, in the past decades a number of initiatives have been undertaken that result in creating frameworks aimed at mapping, increasing knowledge base and assessment of ecosystem services. Such

[7] Adopted from [4].
[8] Ibid.

initiatives include: (1) the Economics of Ecosystems and Biodiversity (TEEB) study [5], which started in 2007[9], has set a framework for valuing ecosystem services; (2) the Common International Classification of Ecosystem Services (CICES), a global initiative developed from the work on environmental accounting undertaken by the European Environment Agency [8]; (3) the Mapping and Assessment of Ecosystems and their Services (MAES), initiative of the EC aiming to provide policy-makers with the best information available on ecosystem services so as to guide land-use planning decisions; (4) the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), an intergovernmental body which, in response to requests from decision makers, assesses the state of biodiversity and of the ecosystem services it provides to society; (5) the Ecosystem Services Partnership; (6) the Integrating Biodiversity Science for Human Wellbeing (DIVERSITAS)[10], an international programme of biodiversity science, established to address complex scientific questions posed by the loss in biodiversity and ecosystem services and to offer science-based solutions to this crisis; (7) the System of Environmental-Economic Accounting (SEEA), a joint initiative of the UN, EC, FAO, OECD and the WB.

For purposes of appraising the economic value of the ecosystem services provided by the Lake Ohrid watershed, by and large the approach of the TEEB and the CICES are followed. The valuation process defined by the TEEB involves three tiers [5]:

1. Recognizing value, i.e. identifying the wide range of benefits in ecosystems, landscapes, species and other biodiversity-linked aspects
2. Demonstrating value, i.e. using economic tools and methods to make nature's services economically visible
3. Capturing value, i.e. incorporating ecosystem and biodiversity benefits into decision-making through incentives and price signals.

From an application aspect, the total economic output value (TEV)[11] of ecosystem services can be divided into two categories of use value (UV) and non-use value (NUV). The UV is further divided into direct use value, indirect use value, and option value. The NUV service category contains existence value, and bequest (heritage/altruist) value (Fig. 4.3). A brief summary description of each value category is given in Table 4.1.

In general, UVs are associated with goods and/or services for which market prices usually exist. Direct use values, which are a sub-category of UV, are related to benefits (goods) obtained from direct use of ecosystem services, such as extractive (e.g. food and/or raw materials) or non-extractive (e.g. aesthetic, recreational benefits from landscapes, etc.). Indirect use values usually refer to regulating services (e.g. air quality regulation, erosion prevention), which can be seen as public services that are generally not reflected in market transactions. Option value is, basically, related to extension of the time-frame in which values are considered, thus giving a possibility of valuing an optional or future use of a given ecosystem service.

Non-use values from ecosystems are those aspects that do not involve direct or indirect uses of ecosystem services. These, in general, reflect the satisfaction that individuals receive from the knowledge that biodiversity and ecosystem services are maintained (existence value), as well as from the knowledge that other people have or will have access to them (bequest/altruist value).

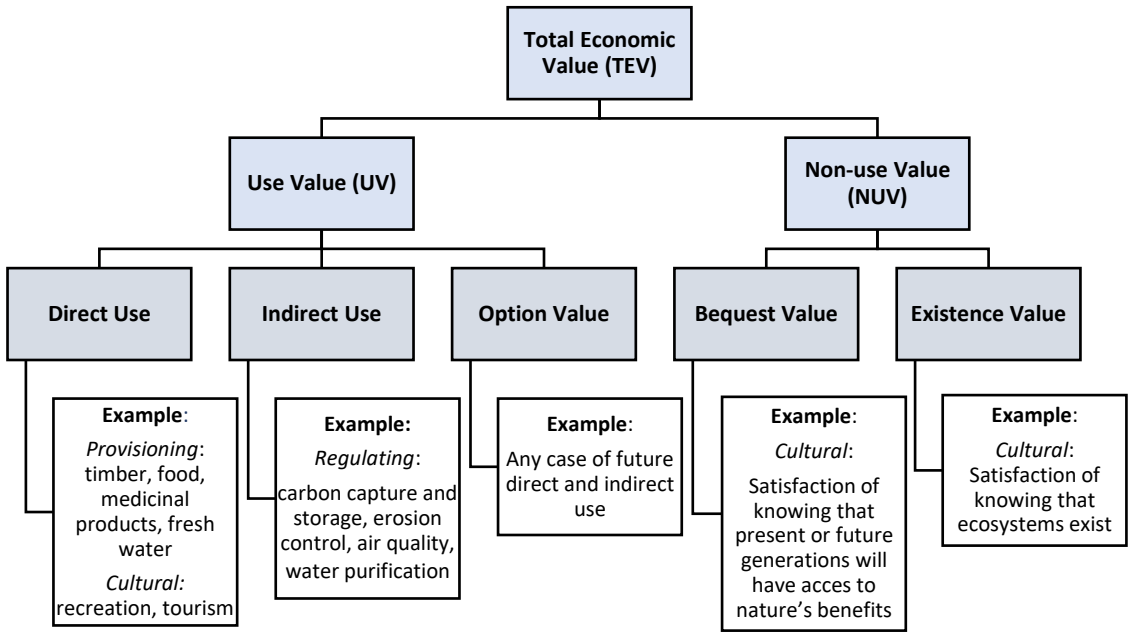
Another aspect related to the value categories of ecosystem services from an application point of view is their relative valuation ('calculation') complexity. Hence, NUV involve much bigger challenges for their valuation than UV, since they are related to aesthetic properties or moral principles for which markets usually do not exist, and which is different from goods or services that are associated with valuation of tangible things or conditions.

[9] In 2007 environment ministers from the governments of the G8+5 countries agreed to "initiate the process of analyzing the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation." The TEEB emerged from that decision. The G8+5 included the G8 nations (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States), plus five emerging economies (Brazil, China, India, Mexico and South Africa).

[10] UNESCO is one of the programme founders.

[11] The TEEB study introduces the TEV concept and makes explicit that "…in assessing trade-offs between alternative uses of ecosystems, the total bundle of ecosystem services provided by different conversion and management states should be included" [7].

Fig. 4.3: Ecosystem services value types[12]



It should be also pointed out that the economic benefits provided by ecosystems are difficult to capture, as well as that the economic valuation of ecosystem services has weaknesses. Several reasons are involved here, including: inherent difficulties associated with defining their values; estimated values remain approximations based on varying methods and assumptions; ecosystem services values are context-specific since the importance of an ecosystem varies according to local conditions; there are evolving views on the environment over time, etc. Further, there are ongoing discussions whether ecosystem services should be assigned marginal or present values, that is whether the value of a service should be associated with increasing or decreasing a specific variable (e.g. unit area of particular ecosystem which provides that service)[13], or based on what is at present with no attempt for assigning marginal values[14]. The latter approach is used in this report.

Table 4.1: Ecosystem services value typology

Value Type	Description
Use Value (UV)	
Direct Use	Results from direct human use of biodiversity (consumptive or non-consumptive)
Indirect Use	Derived from the regulation services provided by species and ecosystems
Option Value	Relates to the importance that people give to the future availability of ecosystem services for personal benefit
Non-use Value (NUV)	
Bequest/Altruist Value	Value attached by individuals to the fact that other people from present of future generations will also have access to the benefits from species and ecosystems
Existence Value	Value related to the satisfaction that individuals derive from the mere knowledge that species and ecosystems continue to exist (changes continuously with human understanding of the services of the ecosystem)

Apart from the marginality aspect, in any ES valuation based on the TEV approach it is also important to identify sources of double counting. In other words, many ecosystem services are not complementary, i.e. the provision

[12] Adopted from [6].
[13] Approach to ES valuation of Costanza at al., 1997.
[14] Approach to ES valuation by Boyd and Banzaf, 2007.

of one is precluded by others. Thus, the range of complementary and competitive services must be distinguished before an aggregated valuation is completed.

Recent research worldwide show that there are significant changes in evaluating methods of ecosystem services value. Some surveys also establish new models for mapping and quantification, as well as for assessment of the stability and sustainability of ecosystems and the services they provide. Of particular importance in this respect are lake and wetland ecosystems, because the interaction of these ecosystems is closely related to occupation factors that, in general, frequently affect human production activities.

Research on the interaction of lake and other ecosystems services is scarce in both North Macedonia and Albania, but as well in the broader Western Balkans region. At the same time, such research and assessments of ecosystem service values that are undertaken in the region are more focused on direct values, often underestimating indirect values. It is our understanding that a lake ecosystem service assessment system should fully reflect the direct contribution of the ecosystem to human well-being, while simultaneously improving the reliability of evaluation results and avoiding overly complex calculations.

4.2. Data Sources

There are a number of important sources of data and publications used in the analysis; detailed bibliography is provided in the report.

The data used in this analysis are divided into two categories: background information and questionnaire data. The background information refer mainly to statistical and other data used for development of the LOWMP. These data refer to the 2016-2018 period. The questionnaire data mainly includes a survey questionnaire to gather an insight into the end-users' (tourists and the local population) perception of the values and benefits arising from the natural characteristics of the LOW, awareness of the pressures impacting the status and quality of the water resources, as well as to determine willingness-to-pay (WTP) for improved protection and overall conditions in the LOW. The survey was conducted in the LOW region in the summer/spring of 2018, as described in other parts of this report.

4.3. Applied Methodology (Valuation Methods)

As mentioned before, the benefits provided by ecosystems are difficult to capture and there are important challenges that are inherent to the process of deriving an economic monetary value of these benefits. In general, within the TEV framework, values are derived from information reflecting the individual behavior provided by market transactions relating directly to an ecosystem service. In the absence of such information, price information must be derived from parallel market transactions that are associated indirectly with the good to be valued. However, if both direct and indirect price information on ecosystem services do not exist, hypothetical markets may be created in order to elicit values. These situations correspond to a common categorization of the available techniques used to value ecosystem services: (a) direct market valuation approaches, (b) revealed preference approaches and (c) stated preferences approaches [7].

Twelve ecosystem services provided by the LOW were valued using economic techniques such as direct and indirect market price and avoided cost (direct market valuation approach), benefit transfer and travel cost (revealed preference approach) and contingent valuation (stated preference approach) methods.

Market prices methods use prevailing prices for goods and services traded in domestic or international markets, and are often used to obtain the value of provisioning ecosystem services, since the commodities produced by provisioning services are often sold. In well-functioning markets preferences and marginal cost of production are reflected in a market price, which implies that these can be taken as an accurate information on the value of commodities.

The ***Avoided cost method*** is another market valuation approach used for valuation of ecosystem services, which relates to the assessment of costs that would have been incurred by the society in the absence of ecosystem services.

Benefit transfer (also called results reference) as a valuation method is defined as the use of research results from pre-existing primary studies at one or more sites (often called study sites) to predict welfare estimates or related information for other typically unstudied sites (often called policy sites). The method is based on use of one or more evaluation methods to estimate the economic value of a similar environmental service function. This estimator is amended and adjusted and then applied to the studied environment.

The ***Travel cost approach*** derives indirectly WTP for environmental benefits (ecosystem services) at a specific location by using information on the amount of money and time that people spend to visit the location. The method is based on the rationale that recreational experiences are associated with a cost, relating to direct expenses and opportunity costs of time, which is taken as a proxy for the value that people attach to a certain ecosystem.

The ***Contingent valuation method*** (CVM) constructs a hypothetical market to elicit respondents' WTP. In general, the CVM is based on use of questionnaires to ask people how much they would be willing to pay to increase or enhance the provision of an ecosystem service. In practice, the CVM is the only method that can measure option and/or existence (altruist) values and provide a true measure of total economic value.

4.4. Valued Ecosystem Services of Lake Ohrid Watershed

4.4.1. Ecosystem services of Lake Ohrid

Drinking water provision

The value of the drinking water supply service to households, commerce and industry was derived using data regarding the volume of annual water abstractions by municipalities in the LOW. The total population connected to public water supply systems, i.e. systems that are operated by a municipal public enterprise, is estimated at 115,842 (88% of the total population), or 56,372 household connections. In addition, roughly 3,700 residents in the basin use local community-based water supply system, and some 12,500 have a self-organized water supply. The number of commercial and industry connections to a public water supply system varies by municipalities with a peak of 2,300 connections in Ohrid, indicating the relatively large number of tourist facilities in the municipality. The total average annual volume of water abstraction for the listed uses is estimated at 14 mill m3. The overall unit water production (water input into the systems) equals 331 l/c/d and, based on data from literature, it varies between 520 l/c/d in Ohrid to 180 l/c/d in Pogradec municipality[15]. The volume of abstracted water is multiplied by the average price of a unit of drinkable water (0.55 $/m^3) defined by local water service companies operating in the LOW[16]. Thus, the estimated economic value of the service equals $5.78 mill annually.

Hydropower generation

Water resources of the LOW are also used for hydropower generation. A total of five small hydropower plants (SHPP) are located in the North Macedonia part of the basin (Fig. 4.4), with installed capacity ranging from 0.2 to 0.6 MW[17]. Apart from the SHPPs located within the LOW boundaries, waters draining from the lake into the Drin River feed a series of seven large cascade hydropower plants (HPP) along the flow to the Adriatic Sea: HPP Globochica and HPP Shpilje in North Macedonia; HPP Fierzë, HPP Komanit, HPP Vau I Dejës and HPPs Ashta 1 and Ashta 2 in Albania (Fig. 4.4). The combined installed capacity of the seven HPPs equals 1,520 MW, and the total annual electricity generation by the plants in 2016 equaled 5,230 GWh (4,700 GWh by HPPs in Albania and 540 GWh by HPPs in North Macedonia)[18]. In addition, over 80% of the total power produced in Albania in 2015 was from HPPs in the Drin basin. Waters from the LOW account for roughly 70% of the electricity generated by the two HPPs in North Macedonia, and 7%-8% of the total electricity generated by the HPP cascade on Drin

[15] Sources: North Macedonia: "Water Supply and Wastewater assessment of existing situation and Gap Analysis", The EU Operational Programme for Regional Development 2007-2013, Eptisa (2015); Albania: International Benchmarking Network for Water and Sanitation Utilities (IBNET, 2014).

[16] The average market price of the water supply service is assumed to be a proxy for the economic value of water used for drinking.

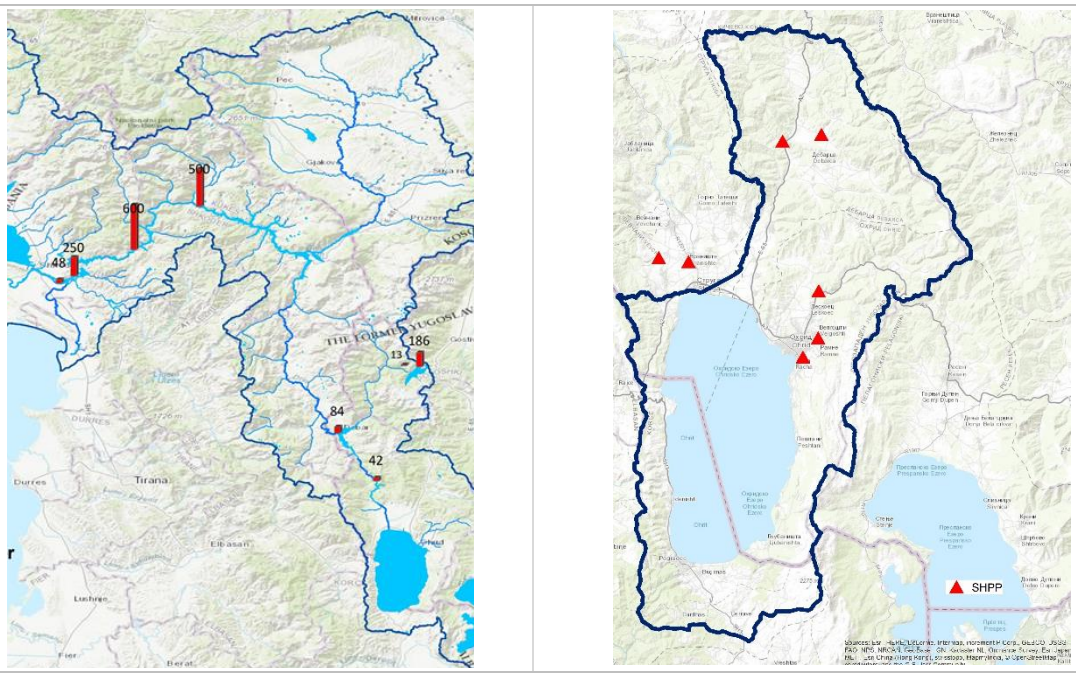
[17] Source: Energy Agency of North Macedonia (http://North.ea.gov.mk).

[18] Source: "Thematic Report on Socio-Economics of the Extended Drin River Basin; The Global Water Partnership – Mediterranean (GWP – Med), November 2017.

River.

The average annual economic value of the hydropower generated using water resources from the LOW (all HPP and SHPP) is derived by multiplying the power generated by all listed power plants in 2016 but using only water quantities that drain from the basin and the average cross-border electricity price in the same year ($74/MWh), equaling $55.53 mill.

Fig. 4.4 Hydropower plants fed by water resources of the LOW – wider Drin River Basin and LOW



Commercial fishery

Commercial fishery occupies an important place in the socio-economic development of the LOW, as it contributes substantially to income generation for some of the most vulnerable groups of the local population. Although Fishery Master Plan for Lake Ohrid exists in both countries (Albania and North Macedonia), adequate fish catch survey in terms of catch structure (size, weight, age and sex) indicating the main determinants for controlling and proper protection of fishes in the lake is lacking. This is mainly a concern for the endemic Salmonid species in the lake – Ohrid Trout and Belvica – that are the main market demanded fish species.

Table 4.2: Fish catch in Lake Ohrid

Lake Ohrid – Fish Species and Catch (t)										
Fish species	Albania			North Macedonia			Total			% (2014)
	2012	2013	2014	2012	2013	2014	2012	2013	2014	
LO trout	50.5	50.0	51.8	0.2	0.9	1.1	50.7	50.9	52.9	28.9%
Belvica	11.7	12.0	12.5	1.0	8.0	14.7	12.7	20.0	27.2	14.9%
Carp	4.2	4.0	4.9	3.6	14.3	21.7	7.8	18.3	26.6	14.6%
European eel				0.2	1.1	1.1	0.2	1.1	1.1	0.6%
Bleak	54.9	58.0	56.1	3.6	5.0	5.7	58.5	63.0	61.8	33.9%
Roach				0.0	0.6	0.0	0.0	0.6	0.0	0.0%
Chub	5.0	4.2	6.5	0.5	3.1	3.1	5.5	7.3	9.6	5.3%
Rudd				0.1	0.1	0.0	0.1	0.1	0.0	0.0%
Barbel				0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Prussian carp	3.4	3.0	3.2	1.0	0.4	0.3	4.4	3.4	3.5	1.9%
Total (t)	**129.7**	**131.2**	**135.0**	**10.1**	**33.4**	**47.6**	**139.8**	**164.6**	**182.6**	**100%**

Based on available data regarding fish catch in 2014 in Lake Ohrid (Table 4.2) and average cross-border fish market prices for 2016[19], the total value of the annual catch in Lake Ohrid is estimated at roughly $1 mill.

[19] Source: UN FAO GLOBEFISH, European Price Report, Issues 2016.

Commercial boating

Cruising and boating are important recreational and tourism activities in Lake Ohrid, and commercial boating is another economic activity directly linked with the ecosystem that is of importance for the local population. Based on information given by the Port Authority in Ohrid, there are two types of watercrafts used in Lake Ohrid – recreation and/or fishing boats (smaller vessels with length up to 12m, largely for personal use) and larger water taxi (sightseeing/passenger) boats used for public transport. There are a total of 2,268 recreation and fishing boats registered by the Port Authority since 1999, of which 500-600 of these are in regular use at present, and 4 sightseeing boats in use on the North Macedonia part of the lake. Nevertheless, it is also reported that some 40-50 private recreation boats are in use for transport of passengers on commercial basis. Data on the boats in use on the Albanian side of the lake are not available; it is estimated, however, that there are not more than roughly 200 small boats used for recreation and fishing.

Table 4.3: Commercial boat transport in Lake Ohrid (North Macedonia)

Lake Ohrid boat transport	2014	2015	2016	2017	2018
Number of passenger boats	4	4	4	4	4
Capacity (passengers)	530	530	530	530	530
Total annual number of passengers	36,620	38,685	30,430	44,510	46,590
Total number of passenger kilometers	741,000	875,000	898,000	1,007,000	1,082,000
Average km/passenger	20	23	29	23	23

Summary information on the commercial boat transport on Lake Ohrid is given in Table 4.3[20], which is used as a key input data in this analysis. The economic value of the service is estimated based on the average number of transported passengers over the 2014-2018 period (approximately 40,000 annually), which is increased by 50% to reflect the commercial transport provided by recreation boats[21], and multiplied by the average ticket price per passenger of $12. Thus, the average annual value of the boating service equals roughly $700,000.

4.4.2. Ecosystem services of forests, protected and agricultural areas in the watershed

Wood materials – timber and fuelwood

The value of wood materials such as timber, fuelwood, etc., is calculated using the market price valuation method. The basis of it is the annual marketable (commercially viable) wood mass, calculated as 75% of the annual biomass growth (m^3), as suggested by the Public Enterprise managing forestry resources in North Macedonia ('Nacionalni Shumi'). The annual biomass growth throughout the watershed is approximately 2% of the total biomass stocks. The wood biomass stocks (m^3) are calculated by multiplying the area under a certain forest type (ha) by its stock volume (m^3/ha; Fig. 4.5). Obtained annual marketable wood mass is 74,686 m^3. In order to obtain the economic value of these wood materials on a watershed level a weighted average price of wood products sold annually by the NP Galichica was calculated (approx. 50 $/$m^3$), and was applied to the marketable wood mass of the entire watershed. The total value of marketable wood materials in the watershed is estimated at $3.74 million per annum.

Medicinal resources (herbs) and food products from forests

A number of studies are available with data on various parts of the LOW relating to terrestrial plant species (herbs) and food products (fungi) present in the watershed forests and protected areas. However, most of these studies focus on the number of plant varieties, biodiversity and protection aspects, whereas very limited data exist regarding their quantities. Therefore, the assessment of the provisioning ecosystem services originating from these areas in the basin is based on secondary sources, i.e. studies [10, 11] that do provide reliable information on the economic value of terrestrial plants and products in the watershed.

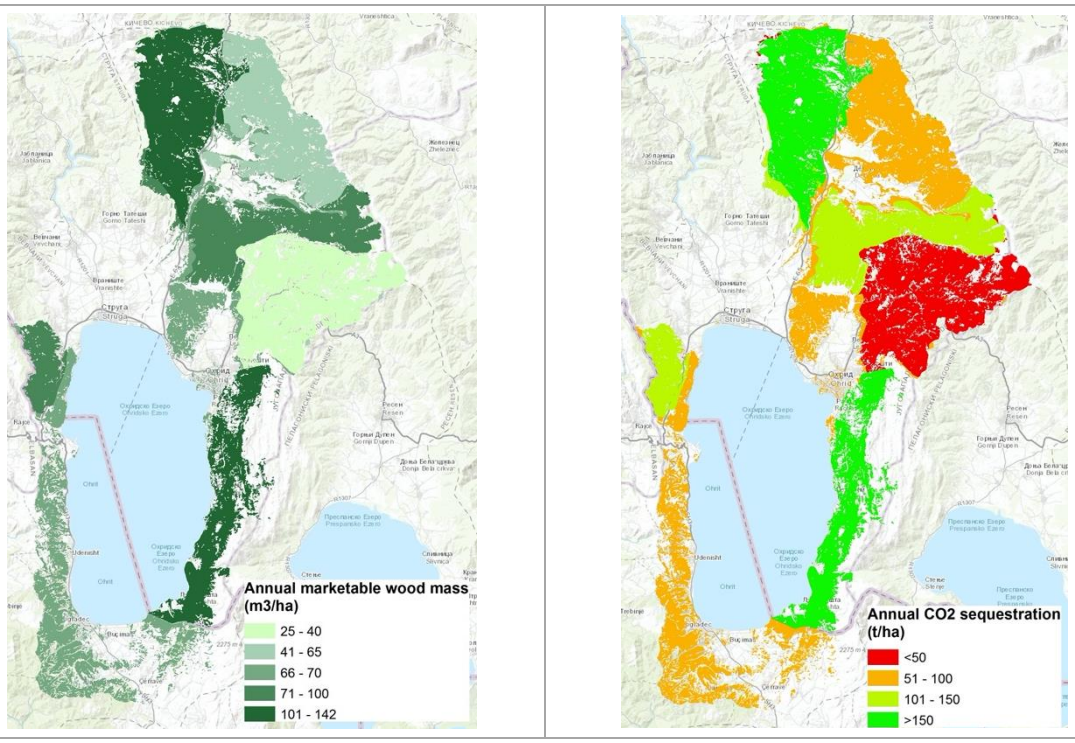
A total of 45 species of medicinal and aromatic herbs are identified in the National Park Galichica in North Macedonia that are od importance for pharmaceutical and cosmetics production, and their total market value

[20] Source: State Statistical Office of North Macedonia (2019).

[21] Source: Expert judgment based on information from the local population and individual service providers.

is estimated at $5.3 mill annually. This figure is increased by roughly $360,000 as a market value for medicinal herbs in the Albanian part of the basin [11]. A total of 364 types of fungi are present in NP Galichica, of which roughly 10 have important commercial value. The market value of the annual production of fungi in the park is estimated at $4mill, and increased by $256,000 as an estimate for Albania [11]. The remaining terrestrial organisms (products) with important commercial/market value are lichen, with estimated total economic value $1.46 mill annually [10].

Fig. 4.5: Annual unit marketable wood mass (m^3/ha) and CO_2 sequestration (t/ha) in LOW



Agricultural production

Agriculture is a dominant form of land management globally, and agricultural ecosystems cover nearly 40% of the terrestrial surface of the Earth (FAO 2009). In the EU agricultural land use is the primary land use accounting for 45% of the territory [9]. Agroecosystems are both providers and consumers of ecosystem services. People value ecosystems mainly for their provisioning services. In turn, agroecosystems depend strongly on a suite of ecosystem services (above all supporting and regulating services) provided by natural ecosystems. Such ES flowing to agriculture include: biological pest control, pollination, water quantity and quality, soil structure and fertility, etc. [18]. It is for this reason why agriculture production is among the valued ecosystem services of the LOW.

Agricultural production in the LOW is by and large organized within small households. Of the total number of households in the Southwestern region in North Macedonia, more than 72% are smaller than 1 ha, while more than 95% are up to 3 ha, divided into several parcels with average size less than 0.1-0.2 ha. Statistical data for Albania reveals similar situation as well, regarding the farm and parcel size. Most of the production is for self-consumption or for green markets during the tourist season.

Estimation of the land use in the North Macedonia part of the LOW is based on the Land Parcel Identification System (LPIS), which allows identification of land use on a parcel level within several categories. For the Albanian part of the basin statistical data coupled with photo-interpretation of a satellite image from 2018 vegetative season (Sentinel 2) was used for identification of areas under different categories of land use.

The total agricultural land in the LOW equals nearly 25,500 ha including pastures (Table 4.4). The category field crops covers major part of the agricultural land (92.6%). Most of the area under field crops, according the data from performed field visits, consist of cereal crops: wheat and maize, and small areas of forage crops, indicating

that the majority of this category is under extensive, low input, systems of agricultural production. There are certain areas of vegetable production within the category of mixed land use mainly within the house yards in the villages, like: potato, cabbage and beans production. More significant production of beans is present in the Cherave region of the LOW in Albania. Orchard and vineyards are more intensive systems of agricultural production with higher inputs of fertilizers and pesticides. The majority of these land use types with a total of 10.44% of the agricultural land are spread in north/north-east part of the basin along Ohrid Lake, as well as in parts in the south near Cherave river and Pogradec. The total area of greenhouses in the watershed is negligible. The remaining part of the agricultural land is covered with meadows, permanent grass land or pastures.

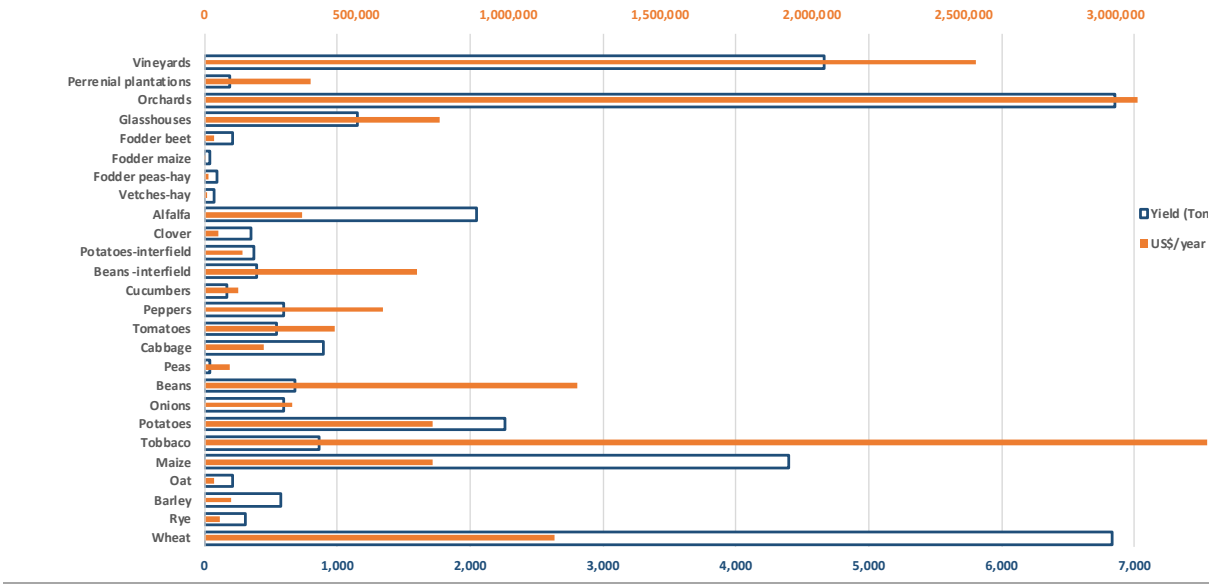
Table 4.4: Land use and agricultural production in the LOW[22]

Water Body	Land use (ha)						
	Field crops	Orchards	Perennial plantations	Mixed per. plantations	Vineyards	Pastures	Total
Lake Water Bodies							
L-Radozhda	21.5	0.7	0.8	0.0	1.6	23.8	48.4
L-Kalishta	118.4	0.1	0.4	0.3	0.0	80.1	199.4
L-Struga-Black Drin	345.8	23.8	5.6	0.4	0.5	118.8	494.9
L-Sateska							
L-Koselska							
L-Ohrid bay							
L-Velidab	137.9	4.6	39.8	1.2	20.4	4,872.6	5,076.6
L-Bay of St. Naum							
L-Tushemisht							
L-Pogradec	950.1	67.4	11.5	0.0	62.4	516.3	1,607.8
L-Udenisht	256.3	17.9	0.0	0.0	16.6	53.1	343.9
L-Lin	204.9	13.1	0.0	0.0	12.2	34.6	264.7
L-Lake Ohrid-Pelagic							
River Water Bodies							
R-Sateska 1	2,054.4	14.6	9.4	0.0	0.4	4,844.1	6,922.8
R-Sateska 2	429.3	91.4	17.7	0.0	106.6	293.4	938.3
R-Sateska 3	810.4	153.5	18.5	1.1	35.1	247.2	1,265.8
R-Koselska 1	12.6	0.6	0.0	0.0	0.0	779.7	793.0
R-Koselska 2	943.0	315.3	28.1	0.9	70.3	1,533.1	2,890.8
R-Cerave	1,370.5	162.0	16.6	0.8	107.0	494.2	2,151.0
R-Sushica	538.4	184.5	41.5	2.2	24.3	1,578.5	2,369.4
AWB- Studenchishki kanal	32.2	4.1	3.7	0.0	9.3	67.3	116.6
Total	**8,225.8**	**1,053.8**	**193.6**	**6.8**	**466.6**	**15,536.8**	**25,483.3**
	32.3%	***4.1%***	***0.8%***	***0.03%***	***1.8%***	***61.0%***	

The average annual economic value of agriculture production is estimated based on the specific crop mix for the basin, multiplied by the average multi-annual yield for each applied crop (Fig 4.6) and by market prices for

Fig. 4.6: Agriculture production – average annual yield (tons) and market value (US$) in the LOW

[22] Source: Lake Ohrid Watershed Management Plan, Draft Report, GWP-Med (2019).



analyzed products in 2018, which are adopted based on the Agricultural Market Information System in North Macedonia (AMIS)[23] and assumed to be applicable to the local market conditions in Albania. Assessed value equals $17.48 mill.

Erosion prevention (soil protection)

The erosion prevention (soil protection) services is provided by forests; it emerges as a decrease in soil erosion for forest land compared to croplands or other land-use types. Thus, the economic value of soil protection is estimated as the avoided cost of restoring soil where erosion might occur. Because forest ecosystems are the most effective in soil protection, the value is estimated by the difference in the potential erosion between forested and non-forested land.

In this analysis non-forest (non-F) land consisted of agricultural areas, scrub and/or herbaceous vegetation associations. Potential erosion levels between forests (F) and non-forests (non-F) land is distinguished in terms of slope using soil erosion risk and slope thematic maps. The slope was calculated by DEM with 25 m of resolution and divided into five categories: <5, 5–10, 10–20, 20–50 and >50%. The results corresponded to the average value of potential erosion for F and non-F in the five slope classes. Main disadvantage was that the erosion map of Albania was obtained at coarser resolution [15], and for a better utilization the dataset was subsequently transformed into points and then nearest neighbor-interpolated, which does not entail a better quality data. However, this form is more suitable for the subsequent erosion hazard assessment. For North Macedonia erosion maps on scale 1:50000 were available [16].

The difference of soil loss, expressed as t/ha/yr for Albania (converted to m^3/km^2 using soil density 1.4 t/m^3) and m^3/km^2 for North Macedonia from F and non-F areas with identical slopes is the basis used for estimating the contribution to erosion reduction, as described in E. Morria et al (2014) [17]. This contribution is multiplied by an average cost for transporting and restoring a unit volume of soil ($12 per m^3). The data shows that the greater forest performance (a higher difference between non-Forested and Forested land) in soil protection mainly occurred in higher slope classes (20–50 and >50%; Table 4.5).

Table 4.5: Soil protection values for corresponding slope classes

Slope	Soil erosion non-F-F m^3	Soil protection value
<5%	236	$ 2,838
5-10%	430	$ 5,160
10-20%	-316	-€ $,797
20-50%	15,159	$ 181,911
>50%	8,555	$ 102,664

[23] Source: http://zpis.gov.mk/About

Total	**24,065**	**$ 288,776**

CO^2 sequestration (Aboveground biomass carbon stock change)

Vegetation accumulates carbon into the biomass through the absorption of atmospheric CO^2. The value of a ton of sequestered carbon can be approximated by the value of tradable emission permits. Carbon is stored in various pools in an ecosystem, including the living biomass, dead organic matter and soil organic matter (IPCC, 2003).

The CO_2 sequestrated annually by the forests in the LOW is calculated based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories [12]. Forested areas for the two years that were considered, 2012 and 2015, were obtained from the Copernicus Land Monitoring Service [13]. The stock volumes were obtained from reports prepared by the NP Galichica [10] and the Public Enterprise managing forestry resources in North Macedonia ('Nacionalni Shumi'). For the areas falling out of the forest enterprises, average values from obtained data were assumed for broadleaved and coniferous forests. Wood densities (ton/m^3) were calculated for both forests types taking into consideration the species composition of broadleaved and coniferous forests of the NP Galichica [10], for which best data is available, and basic wood densities available from literature. The CO_2 stocks for 2012 and 2015 are calculated according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories [12], obtaining a mass of CO_2 stored for the respective years. The increase in CO_2 stock between 2012-2015 is considered the sequestration that occurred in that period, which is divided by 3 to reduce it to an average annual sequestration of 178,170 tons CO_2. A price of $13.5 eur/ton CO_2, a 5-year average (2014-2019) of the European Emissions Allowance (EUA) market [14] is multiplied by the annual CO_2 sequestration, returning a value of $2.42 million worth of annual CO_2 sequestration. Details on the calculation are given in Appendix 1.

4.4.3. Ecosystem services related to the entire watershed

Tourism and recreation

Tourism and recreation are the dominant economic activities in both countries around Lake Ohrid. For several decades Lake Ohrid has been by far the key tourist destination in North Macedonia; since the early 1990-ties it is also a destination with growing significance for tourism in Albania. The climate, geography and physical variety of the territory represented by the lake and mountain ranges accompanied by exceptionally rich biodiversity of flora and fauna, as well as by culture monuments and historical sites, make the entire LOW an attractive and highly-valued tourism site. A number of national parks and nature reserves are also located within the basin, offering possibilities for development of various types of tourism and travel experiences. Finally, Lake Ohrid is declared as a World Heritage Site by UNESCO since 1979.

The key types of tourism activities in the LOW are: (1) Water/lake-based tourism, which includes various kinds of leisure activities in the form of 'beach and sun' tourism; (2) Alternative/adventure tourism, which includes all kinds of rural tourism, eco-tourism and nature-based activities: paragliding, mountain biking, fishing, trekking, climbing, hiking, study tours, etc., in basin's natural parks; (3) Culture and history based tourism, concentrated around the various kinds of archeological and spiritual sites in the region; and (4) Business and transit tourism, is the last type of tourism present in the LOW, which is by and large related to business trips and associated activities (e.g. meetings, conferences, exhibitions) taking place primarily in the bigger cities (municipal centers).

Table 4.6 provides an overview of registered visitors within the LOW for the 2011 – 2017 period. The number of visitors in the region has increased from nearly 290,000 in 2011 to over 410,000 in 2017, which is a 142% increase, while the number of registered overnights has increased from 1.28 million to nearly 1.44 million over the same period.

Table 4.6: LOW: Tourism statistics[24]

[24] Sources: North Macedonia – State Statistical Office; Albania – [11];

Municipality	Administrative Unit	Tourists, domestic and foreign 2011 - 2017							Average
		2011	2012	2013	2014	2015	2016	2017	
Pogradec	Buçimas	51,100	50,000	50,000	50,000	52,500	55,125	57,881	52,372
	Çerravë								
	Dardhas								
	Pogradec								
	Udenisht								
Debrca	N/A								
Ohrid	N/A	178,277	183,335	192,746	197,196	219,944	234,361	275,613	211,639
Struga	N/A	59,079	55,556	59,526	59,171	64,094	74,415	77,238	64,154
TOTAL in LOW		288,456	288,891	302,272	306,367	336,538	363,901	410,732	328,165

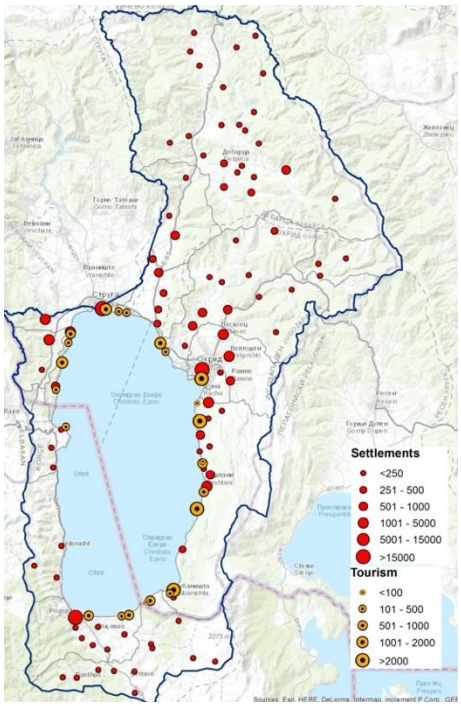
Municipality	Administrative Unit	Overnights, domestic and foreign 2011 - 2017							Average
		2011	2012	2013	2014	2015	2016	2017	
Pogradec	Buçimas	153,300	150,000	150,000	150,000	157,500	165,375	173,644	157,117
	Çerravë								
	Dardhas								
	Pogradec								
	Udenisht								
Debrca	N/A								
Ohrid	N/A	810,795	823,666	796,048	754,048	818,175	830,333	937,041	824,301
Struga	N/A	317,143	295,726	276,920	260,090	300,791	311,624	330,489	298,969
TOTAL in LOW		1,281,238	1,269,392	1,222,968	1,164,138	1,276,466	1,307,332	1,441,174	1,280,387

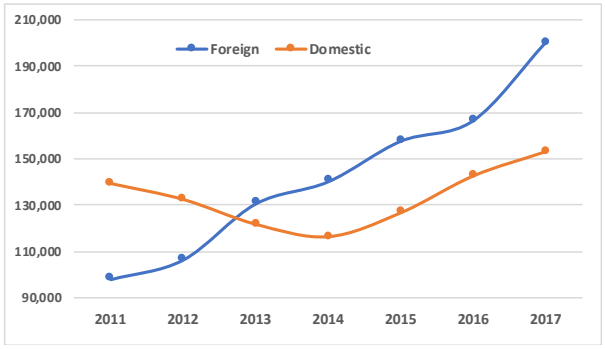
The number of both foreign and domestic visitors has increased in the past decade, albeit at different rates. Thus, in Ohrid and Struga municipalities, for which detailed statistical data are available, the number of foreign visitors has more than doubled over the 2011 – 2017 period, while the number of domestic visitors over the same period has had a declining trend in 2013/14 followed by a constant increase, reaching a 10% increase for the analyzed period as a whole (Fig 4.7).

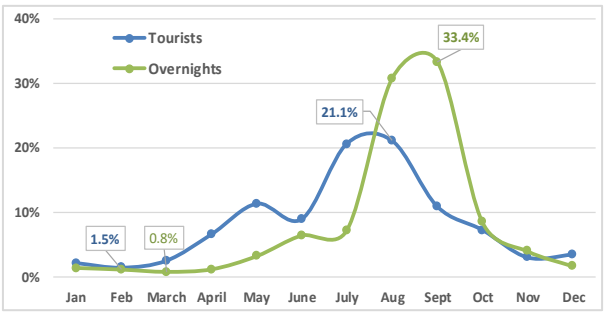
Further, based on available data roughly 73% of the tourists visit the Lake Ohrid region in North Macedonia during the summer period (May through September), and even over 85% of the overnights take place during the June – October period (Fig 4.7). It is assumed that a similar pattern of visitors is applicable also on the Albanian part of the basin.

The major tourism and recreation facilities in the basin are located around the three municipal centers of Pogradec, Ohrid and Struga, but as well along the eastern shoreline (Ohrid town to the village of Peshtani), the south-east part around the villages of Trpejca, Ljubanishta and St. Naum and the north-west section from Struga to Kalishta in North Macedonia, and on the stripe from Tushemisht to Pogradec and the Lin peninsula in Albania (Fig. 4.7).

Fig. 4.7: (1) Major tourism sites in LOW (tourists per day); (2) Foreign/domestic tourist trends in Ohrid and Struga (2011 – 2017); (3) Annual distribution of tourists and overnights in Ohrid and Struga (average 2015 - 2017)







The average annual economic value of tourism and recreation, which represent a specific provisioning ES, is estimated using the Travel cost method. The assessment refers to 2017 and is based on statistical data from the SSO (North Macedonia)[25]. Used data include: average spending by domestic tourists per day/night including transport ($21); average spending by foreign tourists per day/night (on accommodation, food, local transport, other costs – $165); and average spending by foreign tourists on travel to the region ($210). Thus, for the number of foreign and domestic visitors and overnights, the economic value of tourism and recreation in the LOW is $191.44 million as an annual average.

Existence, bequest, spiritual and symbolic values of the LOW

The existence, bequest and spiritual values of the LOW are calculated using the contingent valuation method. The aim of the CVM is to elicit individual preferences (in monetary terms) for values, or changes in quantity and/or quality, of non-marketed goods and services. As mentioned before, a survey was conducted in the Lake Ohrid region for the purpose. The survey was conducted in August/September 2018 and covered 220 residents of the LOW and 212 tourists, both domestic and foreign[26]. Two questionnaires were developed, distributed to administrative units within the Pogradec municipality, and selected settlements in the three municipalities of North Macedonia.

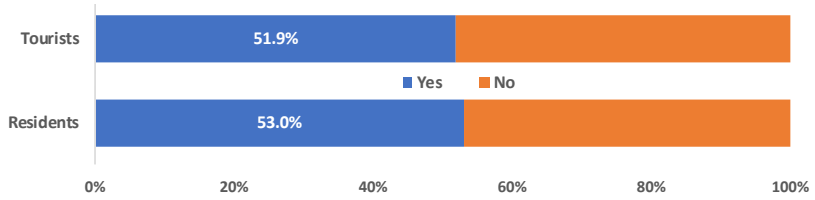
Conducted survey consisted of the following three question groups: (1) Perception of Lake Ohrid Watershed values and benefits; (2) Contingent Valuation of Lake Ohrid Watershed; and (3) Basic Information. Respondents' WTP was obtained from part 2, where the questionnaire asked whether the respondent would be willing to pay money annually to a fund for protection and promotion of water resource and biodiversity in the Lake Ohrid basin. Furthermore, they were asked how much they would pay to the fund annually.

Out of the 212 questioned tourists, 51.9% agreed to contributing annually to the Fund, while 53% of residents answered positively (Fig. 4.8). Residents were asked for the amount they would contribute per household, while the tourists were asked how much they would contribute per person. The majority of both tourists (25.9%) and

[25] It is assumed that official statistical data from the SSO on travel and other expenditures of tourists visiting the Ohrid region is applicable to both countries.

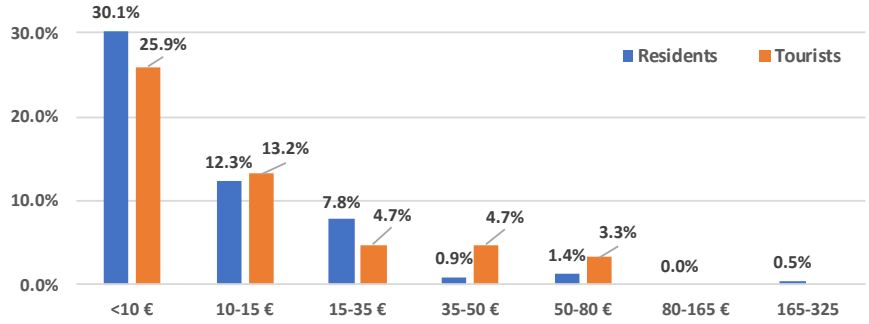
[26] Although the WTP that tourist 'attach' to the ecosystem services of the LOW was revealed using the travel cost method, it is confirmed that the travel cost approach considers only the benefits of direct consumption (use values) of environmental services, which are different from non-use values such as existence and bequest [19]. Thus, educing tourists' WTP for non-use values is regarded as assessing how much they are willing to pay on top of their travel expenses, and therefore not considered as double counting.

Fig. 4.8: Tourists and residents: percentage of respondents willing to contribute resources



local population (30.1%) are willing to contribute less than €10 annually. There is a gradual decrease in the percentage of respondents willing to pay more than €10 to the annual fund, as 12.3% and 13.2% of residents and tourists respectively are ready to pay €10-€15 annually, while only 1.4% (residents) and 3.3% (tourists) are willing to pay €50-€80 (Fig. 4.9).

Fig. 4.9: WTP - % of responses and amounts of annual payment



The mean WTP is calculated as weighted average WTP of the entire sample size. Residents' mean WTP is €8.9 per household annually, while tourists' mean WTP is €9.6 per person (Table 4.7). Based on this analysis, the average spending equals, in monetary terms, the existence, bequest and spiritual values of the LOW of $5.1 mill.

Table 4.7: LOW: Mean WTP

Mean WTP (€)	Residents (per household)	Tourists (per person)
	8.9	9.6

The CVM model further uses WTP as the dependent variable and personal characteristics of respondents as an independent variable, and then uses a logistic model to test the validity of WTP. The entire analysis of WTP and details of other statistical analysis are given in Appendix 2.

An interesting insight, however, provides the overview of the reasons to pay expressed by the survey respondents that are willing to pay (Fig. 4.10), vs. the reasons not to pay given by respondents that answered disapprovingly (Fig. 4.11). Thus, for those that expressed positively their WTP the Lake Ohrid region clearly has bequest value for residents (27% have stated that Lake Ohrid is important for future generations), while the tourist value fairly equally the existence and bequest aspects.

Fig. 4.10: WTP – reasons to pay

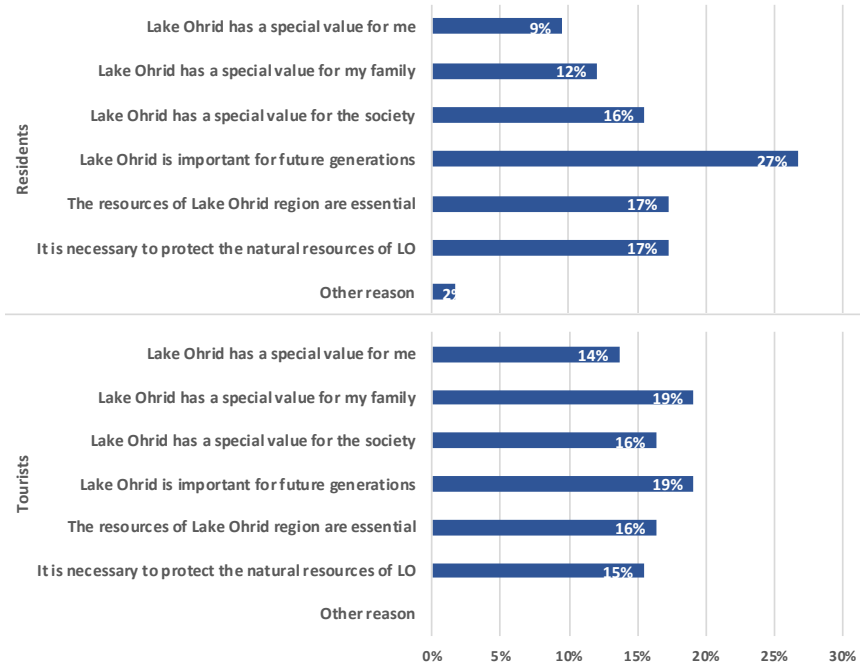
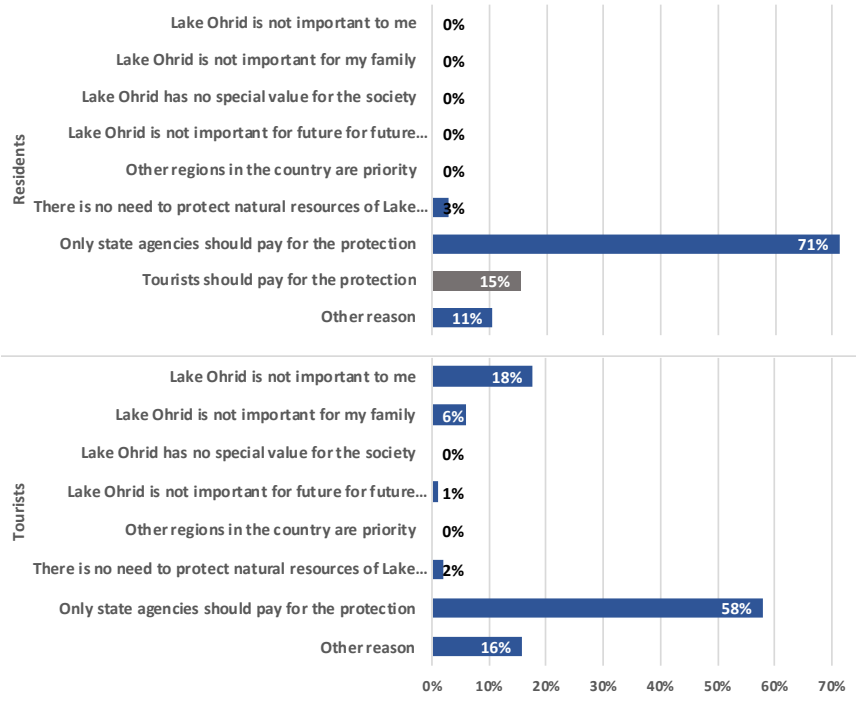


Fig. 4.11: WTP – reasons not to pay



On the other hand, majority of the respondents that answered avertedly to the WTP question have stated that the key reason for not willing to pay is because of their opinion that only state agencies should cover expenses for protection of the lake and its environment. Thus, it can be concluded that majority of these respondents do too assign values to the natural and cultural assets of the region, but the direct responsibility for their protection is in the hands of the authorities using funds levied by regular taxes and charges for the purpose.

5. Results and Conclusions

5.1.1. The TEV of ecosystem services of the LOW and its structure

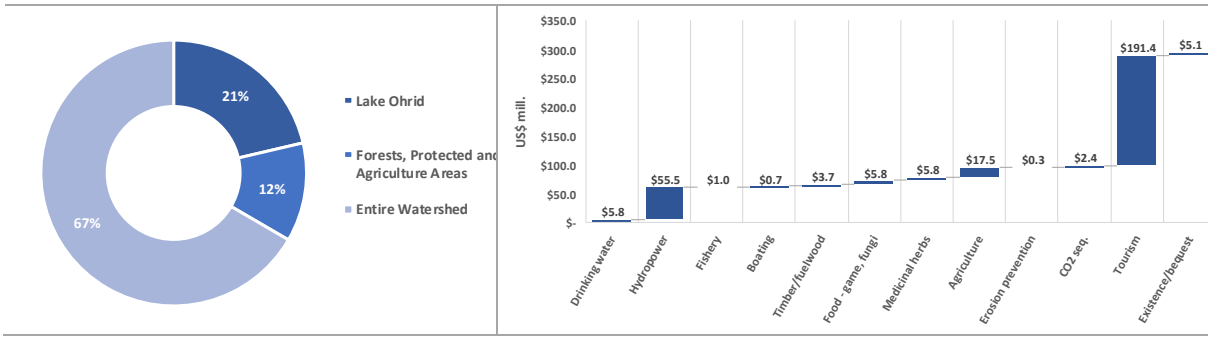
The results of the ES valuation are summarized in Table 5.1 and Fig. 5.1 below. The total value – expressed in monetary units – of the ecosystem services of the LOW in 2017[27] is $295.1 million. The unit value per area, taking into consideration the entire area of the watershed, equals $2,102/ha. Within this, the value of services of Lake Ohrid is $63.3 mill, or 21.4% of the total value; the value of services of forests, protected and agriculture areas within the watershed is $35.52 mill. (12% of the TEV); and the value of services that are related to the entire watershed is $196.55 mill, or 66.6% of the total value.

Table 5.1: Total economic value of LOW ecosystem services

Watershed part	Ecosystem Services	Service Type	CICES Division	Service value type (TEV approach)	Valuation method	Estimated ES value ($)	% of Total
Lake Ohrid	Drinking water - households, industry	Provisioning	Water	Use value - direct	Market price	$ 5,780,135	2.0%
	Hydropower generation	Provisioning	Water	Use value - direct	Market price	$ 55,525,470	18.8%
	Commercial fishery	Provisioning	Water	Use value - direct	Market price	$ 1,016,506	0.3%
	Commercial boating	Provisioning	Water	Use value - direct (NC)	Market price	$ 708,606	0.2%
Forests, Protected and Agriculture Areas	Raw materials -- timber, fuelwood	Provisioning	Biomass	Use value - direct	Market price	$ 3,735,613	1.3%
	Food - game, fungi	Provisioning	Biomass	Use value - direct	Market price	$ 5,774,725	2.0%
	Medicinal resources -- herbs	Provisioning	Biomass	Use value - direct	Market price	$ 5,761,573	2.0%
	Agriculture production (crops)	Provisioning	Biomass	Use value - direct	Market price	$ 17,480,000	5.9%
	Erosion prevention/soil protection	Regulating	Reg. of conditions	Use value - indirect	Avoided cost	$ 346,531	0.1%
	CO2 sequestration	Regulating	Reg. of conditions	Use value - indirect	Market price	$ 2,423,878	0.8%
Entire Watershed	Tourism and recreation	Cultural	Direct interaction	Use value - direct (NC)	Travel cost	$ 191,438,339	64.9%
	Existence/bequest/altruist value	Cultural	Indirect interaction	Non-use value	Contingent valuation	$ 5,114,937	1.7%
NC - non consumptive					**Total Value**	**$ 295,106,314**	100%
					Unit Value ($/ha)	**$ 2,102**	

Viewed from another perspective, the provisioning services value is $78.3 mill, accounting for 26.5%; regulating services value is $2,77 mill, accounting for 1% of the total value; agriculture production service value is $17.48 mill, accounting for 5.9% of the total value[28]; and the cultural (social) service value is $196.55 mill, accounting for 66.6% of the total value. Within the cultural service category, the value of tourism and recreation service is highest, accounting for 64.9% of the total value.

Fig. 5.1: Allocation of the total economic value



The order of analyzed ES by value is: Tourism and recreation ($191.44 mill) > Hydropower generation ($55.53 mill) > Agriculture production ($17.48 mill) > Drinking water supply ($5.78 mill) > Food ($5.77 mill) > Medicinal herbs ($5.76 mill) > Existence/bequest ($5.11 mill) > Timber/fuelwood ($3.74 mill) > CO_2 sequestration ($2.42 mill) > Fishery ($1 mill) > Commercial boating ($0.78 mill) > Soil protection ($0.35 mill).

[27] As indicated before, due to data availability the analysis are for the period 2016 – 2018. However, all valued ecosystem services are on an annual basis, thus 2017 is assumed as an 'average year'.

[28] Agriculture production is assumed as a proxy for supporting services and treated as a separate category from the provisioning (production) services.

In summary, three of the twelve analyzed ES – Tourism and recreation, Hydropower and Agriculture – account for nearly 90% (89.6%) of the total estimated value. Of the remaining services, Drinking water, Food, Medicinal herbs and Existence/bequest, account for 2% of the total each.

5.1.2. Discussion and conclusions

Several methods were combined for valuation of the ecosystem services of the LOW. Essentially, the values of drinking water supply, hydropower, fishery, boating, raw materials, food/fungi, medicinal herbs and carbon sequestration were assessed using monetary values derived from market prices. These services were selected because they are among the most important and can be straightforwardly valued with available data.

The values of erosion prevention/soil protection and tourism and recreation were assessed using surrogate market prices – avoided costs and travel costs respectively. The main contribution to the soil protection service value was provided by forests located in higher slope classes. The carbon sequestration service is likely to be overestimated since cutting and fires were neglected. Simultaneously, some underestimation may be present because of different CO_2 sequestration by forest typologies and volatility of CO_2 market prices.

The ecosystem service of non-use value type – existence/bequest – was assessed using the CVM approach, which educes the individual preferences (respondents' perceptions) gathered with a survey of local residents and visitors of the LOW. Estimated monetary value of $5.1 mill as annual average appears as ambiguous and can be somewhat misleading. It is thought to be a direct consequence of the current relatively low(er) level of local economic development and living standard in both countries sharing the watershed (Albania and North Macedonia), and as such should even be regarded as an affirmative indication. In addition, however, it is also believed that by and large it reflects the true awareness level of the local population regarding the (non)existence of important anthropogenic pressures on natural resources in the basin. Nevertheless, it is likely that the value of this service, when expressed in monetary units, is likely to increase in future.

The recreational ecosystem service, labelled as Tourism and recreation throughout the report, quite expectedly has by far a dominant monetary value among all assessed ecosystem services of the LOW, accounting for no less than 65% of the TEV. This aspect, however, implies further reflection as any change in its value – positive or negative – creates profound changes in the overall status. For example, a 20% increase or decrease of the elements creating the monetary value of the recreation service, given that all other service values remain constant, will result in nearly 15% upward or downward change of the TEV. Thus, taking into consideration that the key attribute creating the monetary value of the recreational ES is the number of visitors to the region, and especially the foreign visitors, an inevitable conclusion is that meticulous attention should be given to the tourists' perceptions of what truly distinguishes the LOW from other recreational sites, as well as to what are the threats (pressures) as seen by the visitors that might negatively affect the current advantages. So, going back to part 3 of this report (Fig. 3.2, 3.3 and 3.6), the key advantages identified by the tourists and local residents include: the biodiversity, aesthetic and natural values, cultural values (spiritual and other heritage sites in the region) and the prominent UNESCO World Heritage Site status; the key pressures on water quality in the lake – or on natural resources, in general – are deficient wastewater and improper solid waste management.

Finally, although a variety of methods to estimate the services were used, the analysis did not establish a complete ecosystem services evaluation system. Nevertheless, notwithstanding the methodological limitations and result uncertainties linked to the needed simplification of ecological processes, it is believed that the analysis provides useful insights suitable for fostering further informed debate concerning the definition of regional resource protection policies. After all, the main objective for conducting the assessment was to generate an indication in the form of order of magnitude regarding the average annual economic (monetary) value and its drivers of the natural and cultural capital of the LOW. Therefore, the inexorable uncertainty of value-based information could be considered acceptable for scoping a strategic management plan for water resource protection at the lake basin scale.

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7. Maps and Annexes

Map 1: Hydrology of LOW

Map 2: LOW – Land Cover

Map 3: LOW – Protected Areas

Appendix 1: Carbon sequestration methodology

The CO_2 sequestrated annually by the forests is calculated by the following formulas, following the 2006 IPCC Guidelines for National Greenhouse Gas Inventories [9]:

$$\Delta C = \frac{(C_{t_2} - C_{t_1})}{(t_2 - t_1)}$$

$$C = A \cdot V \cdot D \cdot (1 + R) \cdot CF$$

Where:

ΔC – annual change in carbon stocks in biomass, tons C yr^{-1}

C_{t1}, C_{t2} – total carbon in biomass at times t_1, t_2, tons C, as calculated by the second equation

A – area of land remaining in the same land-use category, ha

V – stock volume, m^3/ha

D – basic wood density, ton/m^3 biomass

R – ratio of below-ground biomass to above-ground biomass, ton dry mass below-ground biomass / ton d.m. above-ground biomass

CF – carbon fraction of dry matter, ton C / ton d.m.

Forested areas for the two years that were considered, 2012 and 2015, were obtained from the Copernicus Land Monitoring Service [7].

The stock volumes were obtained from reports prepared by the NP Galichica [1][2] and "Nacionalni Shumi" [8]. The stock volumes were calculated for most forest enterprises in the watershed, using the following formula:

$$V = WM/A$$

WM – wood mass, m^3

For the areas falling out of the forest enterprises, average values from the obtained data were taken, for each broadleaved and coniferous forest (65 m^3/ha and 67 m^3/ha for coniferous and broadleaved respectively). When the average values were calculated, the NP Galichica's values were not taken into consideration, as they are significantly higher than the rest of the watershed's (111 m^3/ha and 137 m^3/ha).

The wood densities (ton/m^3) were calculated for both coniferous and broadleaved forests. Taking into consideration the species composition of broadleaved and coniferous forests of the NP Galichica[1][2], for which best data is available, and basic wood densities available from literature [3][5][6], average values for the two types of forests were obtained using the following formula:

$$D_i = \sum D_{i,s} \times \frac{A_{i,s}}{A_{i,tot}}$$

D – basic wood density, for type of forest *i* and species *s,* ton/m^3

$A_{i,s}$ – area falling under type of forest *i* and species *s,* ha

$A_{i,tot}$ – area falling under type of forest *i*, total, ha

The ratio of below-ground to above-ground biomass and the carbon fractions for the two types of forests were obtained from the IPCC Guidelines report[3].

While these calculations give stock and stock variations in mass of carbon, there is further need to convert it to CO_2, using the C to CO_2 mass conversion factor of 3.667 gCO_2/gC.

CO_2 sequestration					
ton CO_2				Economic worth of sequestrated CO_2	
2012	2015	eur/tonCO_2		2012	2015
6580455	**7114963**	11.34		**€ 74,602,274**	**€ 80,661,970**
Annual CO_2 sequestration				Annual	
178170				**€ 2,019,899**	

The mass of CO_2 was economically valuated by considering a 5-year average European Emissions Allowances (EUA) price of CO_2, obtaining a value of 80.6 million euro of CO_2 stocks in 2015, or an annual average sequestrated CO_2 worth of a little more than 2 million euro.

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Appendix 2: Contingent Valuation

In order to understand the reason behind the respondents' WTP a probit linear model was run. The first regression was made for the dependent variable: Would you be willing to contribute resources from your household budget for annual payments in the Fund?, and a selection of independent variables from the conducted survey. A number of variables were selected from two question groups. The first group of questions' goal was to assess the perception of values and benefits of the watershed (1); while the other group (3) aims to picture the social, educational and economical background of the respondents.

With the model ran here, assumptions can be made whether these factors influence the respondents' WTP. The most statistically significant independent variables from the above mentioned question groups are reported in tables 1 and 2, for residents and tourists respectively, as the two are considered separate socio-demographic groups with different views and priorities who cannot be grouped together.

Table 1 Residents regression parameters WTP (yes/no)

Dependent variable: Would you be willing to contribute resources from your household budget for annual payments in the Fund? (residents)			
Parameter	**B**	**Std. Error**	**Sig.**
Hydrological regulation: flood protection, erosion prevention, water retention/landscape	-0.533	0.2986	0.074
Maintenance of biological diversity (populations and habitats)	1.011	0.3754	0.007
Protection of region's prominent status (UNESCOsite, etc.)	0.477	0.2469	0.053
Unsustainable (intense) fishing	-0.431	0.2098	0.040
Introduced invasive alien species in the lake	0.474	0.2373	0.046
Education	0.290	0.1384	0.036
Percentage of all family income that is directly connected to Lake Ohrid	0.338	0.1338	0.011
Have you donated for humanitarian/development activity in the last two years?	-0.702	0.2774	0.011

The most statistically significant independent variable for the local population is "Maintenance of biological diversity", meaning that the people who place high importance on Ohrid Lake's help in the maintenance of existing biodiversity are also willing to pay to the annual fund (Figure 1.a).

Other statistically significant independent variables are the level of education (the higher the education level the more prone people are to contributing to the fund (Figure 1.b) and the percentage of the family monthly income that is directly connected to Lake Ohrid (the higher the percentage, the more willing to pay).

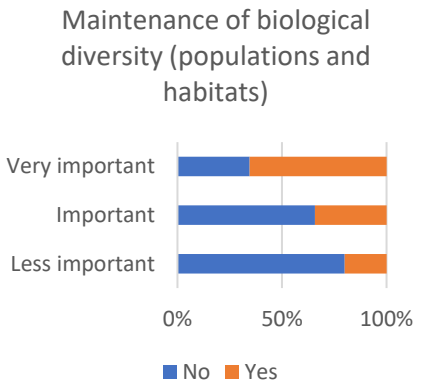


Figure 1.a WTP (yes/no) and biodiversity benefit (residents)

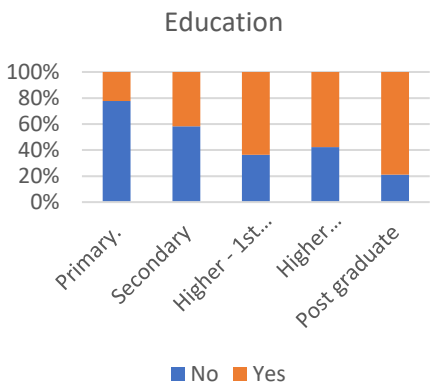


Figure 71.b WTP(yes/no) and education levels (residents)

While the regression model did not show a statistical significance between WTP and total household earnings, from Figure 2 it is visible that the more a family earns the more probable they are to contribute to the fund, with the exception of the last income bracket (more than 100.000 MKD). However, this bracket only consists of one single individual.

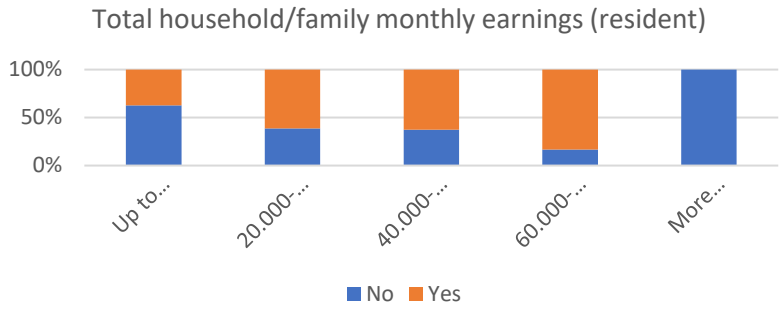


Figure 2 WTP (yes/no) and income levels (residents)

As regards the tourists, the findings are strange to some extent. Those who believe that protection of the water biodiversity is a non-important benefit that the good water quality of the watershed provides are those that are willing to pay to the annual fund. The trend is the same with those who believe intense fishing has minor or no effect on the water quality and biodiversity. However, those that are not satisfied with water quality in the lake are more willing to pay than those who are.

Furthermore, the awareness regarding the endemism of Lake Ohrid is positively correlated to the respondents' willingness to pay (Figure 3), even though the regression coefficient is not that strong (0.383). For both tourists and residents, there is a positive correlation between WTP and whether the respondent has donated for humanitarian/development activities in the past two years, however the statistical significance is much better for residents ($p<0.05$) compared to tourists ($p<0.07$).

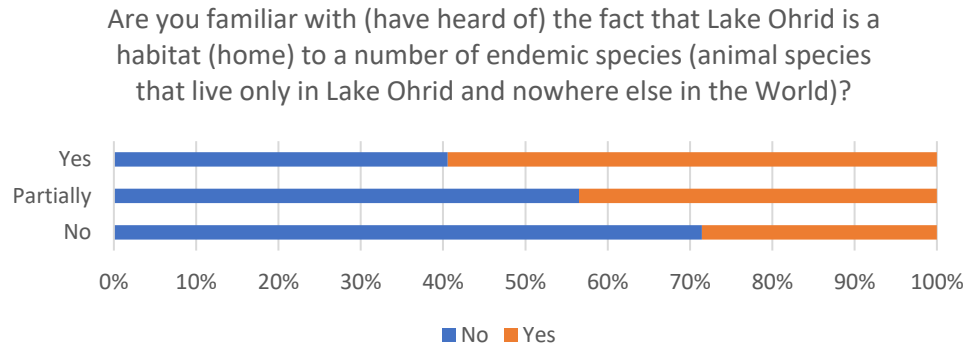


Figure 71 WTP(yes/no) and Lake Ohrid endemism awareness (tourists)

Table.2 Tourists regression parameters WTP (yes/no)

Dependent variable: Would you be willing to contribute resources from your household budget for annual payments in the Fund? (tourists)			
Parameter	**B**	**Std. Error**	**Sig.**
Protection of biological diversity	-0.993	0.3444	0.004
Increased tourism	-0.348	0.1977	0.078
Are you satisfied with the quality of the water in Lake Ohrid?	-0.586	0.2451	0.017

Are you familiar with (have heard of) the fact that Lake Ohrid is a habitat (home) to a number of endemic species (animal species that live only in Lake Ohrid and nowhere else in the World)?	0.383	0.1892	0.043
Large number of boats/vessels in the lake – emission of hazardous substances in the water	0.476	0.2155	0.027
Unsustainable (intense) fishing	-0.461	0.2308	0.046
Have you donated for humanitarian/development activity in the last two years?	-0.446	0.2417	0.065

Apart from a regression where the dependent variable is whether the respondent is willing to pay to the annual fund, an ordinal probit linear regression model was run with the dependent variable being: How much are you prepared to pay in the Fund annually, again, for residents and tourists separately, with the same selection of independent variables. The goal of this model run is to identify the most important factors that guide the amount of money a respondent's willing to pay in the annual fund. For residents there are 6 independent variables with a strong statistical significance ($p<0.05$) and 3 more with a significance $p<0.07$ (Table 3).

Table 3 Residents regression parameters WTP (amount prepared to pay)

Dependent variable: How much are you prepared to pay in the Fund annually? (residents)

Parameter	B	Std. Error	Sig.
Aesthetic and natural values of the region	3.005	0.5670	0.000
Cultural values: historical heritage; cultural heritage; educational, scientific, religious values	-1.711	0.4360	0.000
Improved quality of living	-1.949	0.6768	0.004
Improved health conditions	1.121	0.6139	0.068
Improved water supply (for all needs)	0.898	0.3851	0.020
Are you satisfied with the quality of the water in Lake Ohrid?	-0.519	0.2783	0.062
Large number of tourist accommodation and hospitality facilities around the lake	-1.020	0.3760	0.007
Large number of individual recreational facilities (weekend/holiday houses)	-0.776	0.3958	0.050
Large number of boats/vessels in the lake – emission of hazardous substances in the water	0.851	0.4574	0.063

The strongest positive correlation with the highest significance independent factor is with the "Aesthetic and natural values of the region" benefit; i.e. those who believe the aesthetic and natural values are very important benefits provided by Lake Ohrid are willing to leave more money in the fund annually. On the other hand, there is a strong negative correlation with the "cultural values" benefit that Lake Ohrid provides, as well as with the "improved quality of living" benefit. There is no significant correlation between the amount residents are willing to pay and any of the socio-economic variables (from the (3) group of questions).

Table 4 Tourists regression parameters WTP (amount prepared to pay)

Dependent variable: How much are you prepared to pay in the Fund annually? (tourists)

Parameter	B	Std. Error	Sig.
How often do you visit the Lake Ohrid region?	-0.252	0.1271	0.047
Water supply	1.810	0.5084	0.000
Commercial and recreational fishing	-0.779	0.3827	0.042
Aesthetic and natural values of the region	-1.160	0.6211	0.062
Increased/sustainable fishery	-0.891	0.4064	0.028
Improved water supply (for all needs)	1.369	0.4749	0.004
Discharge of untreated wastewater (sewage) into the lake	-0.937	0.4726	0.047
Obsolete (not fully functional) sewage collecting system	-1.871	0.5545	0.001
Large number of tourists during the summer season	0.633	0.3131	0.043
Climate change	0.904	0.3545	0.011
Education	0.708	0.2294	0.002

Total household/family monthly earnings (tourist)	0.893	0.2144	0.000

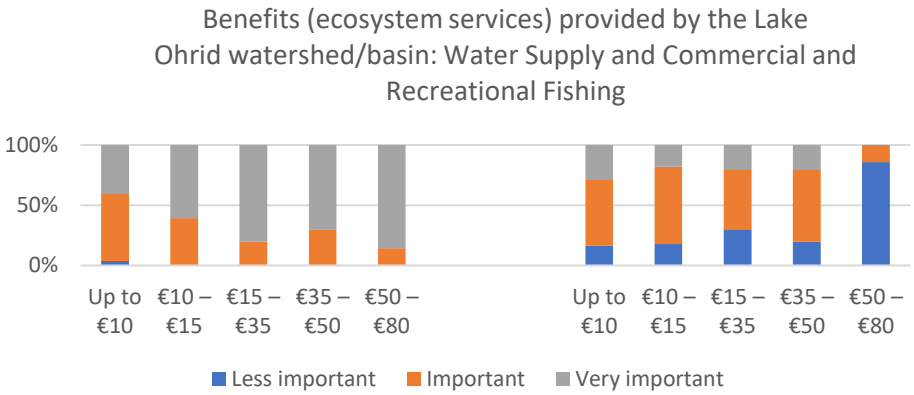


Figure 4.a WTP(amount prepared to pay) and water supply benefit (tourists)

Figure 4.b WTP(amount prepared to pay) and commercial and recreational fishing benefit (tourists)

As for the tourists, there are 11 variables with $p<0.05$ and 1 more with a $p<0.07$ significance. (see table 4) The strongest correlation with the biggest significance is with the "water supply" benefit. The more important water supply is in tourists' eyes, the more money they are willing to leave in the fund. On the contrary, the correlation with the "commercial and recreational fishing" benefit is negative. (see figures 4.a & b) While for the residents the socio-economic independent variables had no significant impact over the WTP, for tourists there are positive correlations with both education and total household income, hence tourists that earn more and are better educated are also willing to leave more money in the fund (Figure 5).

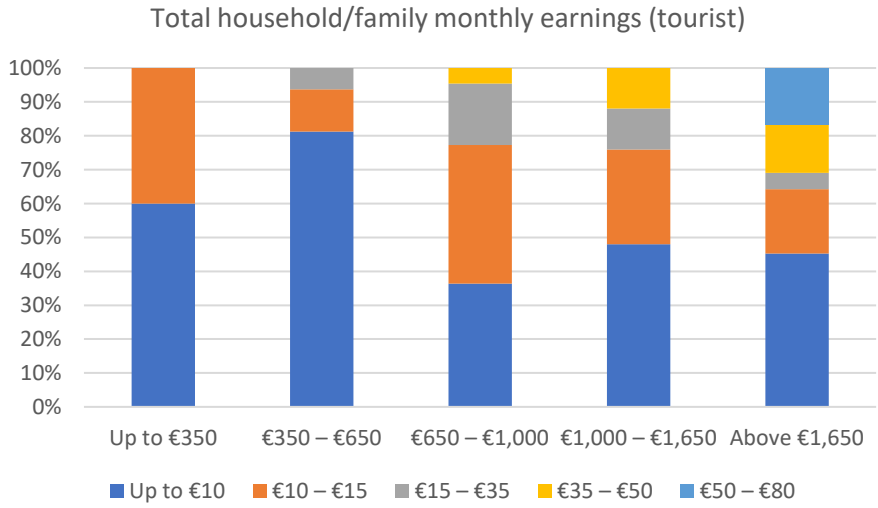


Figure 5 WTP(amount prepared to pay) and income levels (tourists)

Appendix 3: Survey Questionnaires

PERCEPTION OF THE VALUES AND BENEFITS AND CONTINGENT VALUATION OF THE LAKE OHRID WATERSHED – STAKEHOLDER SURVEY
(Local population/Residents)

With a maximum depth of 290 meters and average depth of 155 meters, straddled in the mountainous region between the southwest part of R. Macedonia and the eastern part of R. Albania, Lake Ohrid is one of the oldest and deepest lakes in Europe. The lake is located at an altitude of 693 meters and has an area of 358 square kilometers. With an estimated age of 2 to 5 million years, the lake represents a unique aquatic ecosystem. Of the 1,200 registered animal species in the lake, 212 are considered endemic. The importance of the lake is further emphasized with its declaration as a World Heritage Site by UNESCO in 1979. With all its amenities and values the lake also represents the most important tourist center in R. Macedonia.

As a result of a prolonged economic development of lake's region focused primarily on promotion of tourism activities, the natural characteristics and habitats along the lake shoreline have changed, especially in the areas around Ohrid, Struga, Peshtani, St. Naum (R. Macedonia), Tushemisht and Pogradec (R. Albania). The native reed belt along the coastline, which serves as a spawning site for many fish species and an important wintering site for birds, in these regions has been drastically reduced, leading to an increased nutrient enrichment and thus to stimulated growth of new aquatic plants. Additionally, as a result of unsustainable harvesting of commercially important fish species, several endemic fish species in the lake are in immediate danger of collapse.

At present, within the "*Enabling Transboundary Cooperation and Integrated Water Resources Management in the Extended Drin River Basin*" Project (drincorda.org), which is financed by the Global Environmental Facility (GEF) and implemented by the United Nations Development Programme (UNDP) and the Global Water Partnership - Mediterranean (GWP-Med), a ***Lake Ohrid Watershed Management Plan*** is under development. Preparation of the Plan is a pilot activity under the Project, and its key objective is development of a strategic planning document aimed at integrated management of water resources in Lake Ohrid's watershed, in compliance with the EU Water Framework Directive (WFD) and the pertinent legislation for water resource management of R. Albania and R. Macedonia.

With the goal of identifying and selecting efficient water resource management and monitoring measures the development of the Plan includes a comprehensive socio-economic analysis of water resource use, but as well valuation of the wider benefits (ecosystem services) emerging from the specifics of the aquatic and other ecosystems within lake's watershed. Therefore, the key objective of this Survey is gathering an insight into the end-users' perception of the values and benefits arising from the natural characteristics of Lake Ohrid's watershed.

The Survey is anonymous. We would like to thank you in advance for your answers, which are of vital importance and will be used exclusively for the purposes of listed analysis and development of the Lake Ohrid Watershed Management Plan.

Sincerely,

Part 1. Perception of Lake Ohrid Watershed values and benefits

1.1 Do you live permanently in the Lake Ohrid region/basin (permanent residence)?

☐ Yes	☐ No

1.2 If NO, how much time during the year you stay continuously in the region?

☐ Less than 1 month	☐ 1 – 2 months	☐ 2 – 3 months
☐ 3 – 6 months	☐ 6 – 9 months	☐ > од 9 months

1.3 Is your primary occupation linked directly to Lake Ohrid?

☐ Yes	☐ No

1.4 If YES, what is your primary occupation? _____

1.5 Do you have an additional occupation or hobby which is linked directly to Lake Ohrid?

☐ Yes	☐ No

1.6 If YES, what is your additional occupation or hobby? _____

1.7 Lake Ohrid's watershed provides numerous benefits for the population. Several benefits are listed in the table below. Please rank these benefits according to your perception of their importance:

Benefits (ecosystem services) provided by the Lake Ohrid watershed/basin	Less important	Important	Very important
Water supply			
Electricity generation (along the Drin river, downstream of the lake)			
Commercial and recreational fishing			
Commercial and recreational boating			
Favorable conditions for tourism and recreation (all types)			
Hydrological regulation: flood protection, erosion prevention, water retention/landscape			
Maintenance of biological diversity (populations and habitats)			
Aesthetic and natural values of the region			
Cultural values: historical heritage; cultural heritage educational, scientific, religious values			

1.8 Maintenance of good water quality in Lake Ohrid, as well as in the rivers within the basin, is a key requirement for provision of the benefits listed in the previous question. The table below includes several benefits which are closely linked with water resource quality in the basin. According to your opinion, please rank these benefits based on assessed importance:

Benefits/Rank	Less important	Important	Very important
Protection of region's overall aesthetic values/ amenities			
Protection of biological diversity			
Protection of region's overall cultural values/ heritage			
Improved quality of living			
Improved health conditions			
Increased conditions for recreation and sport activities			
Increased tourism			
Increased/sustainable fishery			
Improved water supply (all needs)			
Improved conditions for industrial/economic development (SME; entrepreneurship)			
Protection of region's prominent status (UNESCO-site, etc.)			

1.9 Are you satisfied with the quality of the water in Lake Ohrid?

☐ Yes	☐ No	☐ Partially

1.10 If your answer to the previous question is "Not satisfied" or "Partially satisfied", please explain why?

_____

_____

_____

1.11 Are you familiar with the EU principles and standards for environmental protection?

☐ Yes	☐ No	☐ Partially

1.12 Are you familiar with the EU principles and standards for water resource protection (Water Framework Directive – WFD)?

☐ Yes	☐ No	☐ Partially

1.13 Are you familiar with (have heard of) the fact that Lake Ohrid is a habitat (home) to a number of endemic species (animal species that live only in Lake Ohrid and nowhere else in the World)?

☐ Yes	☐ No	☐ Partially

1.14 According to your opinion, are the endemism and biodiversity of Lake Ohrid values of essential importance?

☐ Fully disagree	☐ Disagree	☐ No opinion	☐ Agree	☐ Fully agree

1.15 According to your opinion and based on presumed intensity of the negative effect, please rank listed pressures on the quality of the water in Lake Ohrid and the entire watershed, as well as on the biodiversity supporting the basin:

Pressures/Rank	Minor (No) effect	Medium effect	Strong effect
Discharge of untreated wastewater (sewage) into the lake			
Obsolete (not fully functional) sewage collecting system			
Large number of tourist accommodation and hospitality facilities around the lake			
Large number of individual recreational facilities (weekend/holiday houses)			
Inappropriate urbanization – construction density at certain localities			
Large number of boats/vessels in the lake – emission of hazardous substances in the water			
Large number of tourists during the summer season			
Inappropriate lake shorezone management (beaches)			
Unsustainable (intense) fishing			
Introduced invasive alien species in the lake			
Inappropriate solid waste management around the lake (illegal dumps)			
Surface runoff from agricultural land			
Inappropriate management of protected areas and forests in the basin			
Inappropriate and obsolete transport infrastructure			
Climate change			
Other, please list and rank:			

1.16 According to your opinion, which stakeholder (user) do you think will have the largest benefit from maintenance of water quality in Lake Ohrid? Please rank listed stakeholders from 1 (lowest) to 5 (highest) benefit.

☐ Households (local population) _____

☐ Tourist facilities (resorts) _____

☐ Businesses (small and medium enterprises and individual entrepreneurs) linked with tourism (e.g. accommodation, boating, fishermen...) _____

☐ Local industry _____

☐ Other, please state and rank: _____

1.17 Which institution do you think holds prime responsibility for maintenance of good water quality in the lake? Please rank listed institutions from 1 (lowest responsibility) to 5 (highest responsibility).

☐ Municipalities and public communal enterprises around the lake _____

☐ Regional government units (centers) _____

☐ The central government (responsible ministries ad agencies) _____

☐ Other, please state and rank: _____

1.18 Which institution do you think at present contributes the most for maintenance of good water quality in the lake? Please rank listed institutions from 1 (lowest contribution) to 5 (highest contribution).

☐ Municipalities and public communal enterprises around the lake _____

☐ Regional government units (centers) _____

☐ The central government (responsible ministries ad agencies) _____

☐ Other, please state and rank: _____

Part 2. Contingent Valuation of Lake Ohrid Watershed

The responsible state institutions for environmental protection, in coordination with the local self-governments from the Ohrid region, intend to establish a multi-year program for integrated management of water resources in Lake Ohrid's watershed, in compliance with the EU standards (WFD). Suppose that a special voluntary "Fund for protection and promotion of water resource and biodiversity in the Lake Ohrid basin" is planned to be established for the purpose. Fund's resources will be used for development of policies and financing of concrete infrastructure projects aimed at improving the overall conditions in the Lake Ohrid basin.

2.1 Would you be willing to contribute resources from your household budget for annual payments in the Fund?

☐ Yes	☐ No

2.2 If your answer to the previous question is YES, how much are you prepared to pay in the Fund annually?

☐ Up to 500 MKD	☐ 500 – 1,000 MKD	☐ 1,000 – 2,000 MKD	☐ 2,000 – 3,000 MKD
☐ 3,000 – 5,000 MKD	☐ 5,000 – 10,000 MKD	☐ 10,000 – 20,000 MKD	☐ Above 20,000 MKD

2.3 If your answer to question 2.1 is YES, which is the prime reason (please check only the most important answer)?

☐ Lake Ohrid has a special value for me	☐ Lake Ohrid has a special value for my family	☐ Lake Ohrid has a special value for the society
☐ Lake Ohrid is important for future generations	☐ The resources of Lake Ohrid region are irreplaceable/essential	☐ It is necessary to protect the natural resources of Lake Ohrid
☐ Other, please explain: _____ _____		

2.4 If your answer to question 2.1 is NO, which is the prime reason (please check only the most important answer)?

☐ Lake Ohrid is not important to me	☐ Lake Ohrid is not important for my family	☐ Lake Ohrid has no special value for the society
☐ Lake Ohrid is not important for future generations	☐ Other regions in the country are priority	☐ There is no need to protect natural resources of Lake Ohrid
☐ Only state organizations/agencies should pay for the protection		
☐ Other, please explain: _____ _____		

Part 3: Basic information

Please provide your basic demographic information:

3.1 Gender ☐ Female ☐ Male

3.2 Age _____

3.3 Education

☐ Primary	☐ Secondary	☐ Higher – 1st degree	☐ Higher (University)	☐ Post-graduate

3.4 Employment/occupation

☐ Student	☐ Full-time employed	☐ Part-time employed	☐ Unemployed	☐ Retired

3.5 Total household/family earnings

☐ Up to 20,000 MKD	☐ 20,000 – 40,000 MKD	☐ 40,000 – 60,000 MKD	☐ 60,000 – 100,000 MKD	☐ Above 100,000 MKD

3.6 Percentage of the total household earnings which are directly linked with Lake Ohrid (See question 1.3)

☐ 0%	☐ 0 – 25%	☐ 25 – 50%	☐ 50 – 75%	☐ 75 до 100%

3.7 Are you an active member of an environmental organization?

☐ Yes	☐ No

3.8 Have you donated for environmental protection purposes in the last two years?

☐ Yes	☐ No

3.9 Are you an active member of any other kind of humanitarian/development organization?

☐ Yes	☐ No

3.10 Have you donated for humanitarian/development activity in the last two years?

☐ Yes	☐ No

The Survey is anonymous. Please do not sign the Questionnaire!

PERCEPTION OF THE VALUES AND BENEFITS AND CONTINGENT VALUATION OF THE LAKE OHRID WATERSHED – STAKEHOLDER SURVEY (Visitors/Tourists)

With a maximum depth of 290 meters and average depth of 155 meters, straddled in the mountainous region between the southwest part of R. Macedonia and the eastern part of R. Albania, Lake Ohrid is one of the oldest and deepest lakes in Europe. The lake is located at an altitude of 693 meters and has an area of 358 square kilometers. With an estimated age of 2 to 5 million years, the lake represents a unique aquatic ecosystem. Of the 1,200 registered animal species in the lake, 212 are considered endemic. The importance of the lake is further emphasized with its declaration as a World Heritage Site by UNESCO in 1979. With all its amenities and values the lake also represents the most important tourist center in R. Macedonia.

As a result of a prolonged economic development of lake's region focused primarily on promotion of tourism activities, the natural characteristics and habitats along the lake shoreline have changed, especially in the areas around Ohrid, Struga, Peshtani, St. Naum (R. Macedonia), Tushemisht and Pogradec (R. Albania). The native reed belt along the coastline, which serves as a spawning site for many fish species and an important wintering site for birds, in these regions has been drastically reduced, leading to an increased nutrient enrichment and thus to stimulated growth of new aquatic plants. Additionally, as a result of unsustainable harvesting of commercially important fish species, several endemic fish species in the lake are in immediate danger of collapse.

At present, within the "*Enabling Transboundary Cooperation and Integrated Water Resources Management in the Extended Drin River Basin*" Project (www.drincorda.org), which is financed by the Global Environmental Facility (GEF) and implemented by the United Nations Development Programme (UNDP) and the Global Water Partnership - Mediterranean (GWP-Med), a ***Lake Ohrid Watershed Management Plan*** is under development. Preparation of the Plan is a pilot activity under the Project, and its key objective is development of a strategic planning document aimed at integrated management of water resources in Lake Ohrid's watershed, in compliance with the EU Water Framework Directive (WFD) and the pertinent legislation for water resource management of R. Albania and R. Macedonia.

With the goal of identifying and selecting efficient water resource management and monitoring measures the development of the Plan includes a comprehensive socio-economic analysis of water resource use, but as well valuation of the wider benefits (ecosystem services) emerging from the specifics of the aquatic and other ecosystems within lake's watershed. Therefore, the key objective of this Survey is gathering an insight into the end-users' perception of the values and benefits arising from the natural characteristics of Lake Ohrid's watershed.

The Survey is anonymous. We would like to thank you in advance for your answers, which are of vital importance and will be used exclusively for the purposes of listed analysis and development of the Lake Ohrid Watershed Management Plan.

Sincerely,

Part 1. Perception of Lake Ohrid Watershed values and benefits

1.1 How often do you visit the Lake Ohrid region?

☐ 1 – 2 times per year	☐ 3 – 5 times per year	☐ 5 – 10 times per year	☐ More than 10 times per year
☐ Less than once per year	☐ Never	☐ I live (have house/apartment) in the region	

1.2 What are the main reasons for your visit? (multiple answers; list everything you find applicable)

☐ Recreation, sport, adventure-tourism, eco-tourism	☐ Annual vacation	☐ Visiting of historic, religious, cultural amenities
☐ Visiting relatives/friends	☐ Business trips	☐ Other, state:

1.3 What is the average length of your stay during your visit to the region?

☐ 1 day	☐ 2 – 3 days (weekend)	☐ 5 days
☐ 5 – 10 days	☐ 10 – 15 days	☐ More than 15 days

1.4 Lake Ohrid's watershed provides numerous benefits for the population. Several benefits are listed in the table below. Please rank these benefits according to your perception of their importance:

Benefits (ecosystem services) provided by the Lake Ohrid watershed/basin	Less important	Important	Very important
Water supply			
Electricity generation (along the Drin river, downstream of the lake)			
Commercial and recreational fishing			
Commercial and recreational boating			
Favorable conditions for tourism and recreation (all types)			
Hydrological regulation: flood protection, erosion prevention, water retention/landscape			
Maintenance of biological diversity (populations and habitats)			
Aesthetic and natural values of the region			
Cultural values: historical heritage; cultural heritage; educational, scientific, religious values			

1.5 Maintenance of good water quality in Lake Ohrid, as well as in the rivers within the basin, is a key requirement for provision of the benefits listed in the previous question. The table below includes several benefits which are closely linked with water resource quality in the basin. According to your opinion, please rank these benefits based on assessed importance:

Benefits linked with good water quality/Rank	Less important	Important	Very important
Protection of region's overall aesthetic values/ amenities			
Protection of biological diversity			
Protection of region's overall cultural values/ heritage			
Improved quality of living			
Improved health conditions			
Increased conditions for recreation and sport activities			
Increased tourism			
Increased/sustainable fishery			
Improved water supply (for all needs)			
Improved conditions for industrial/economic development (SME; entrepreneurship)			
Protection of region's prominent status (UNESCO-site, etc.)			

1.6 Are you satisfied with the quality of the water in Lake Ohrid?

☐ Yes	☐ No	☐ Partially

1.7 If your answer to the previous question is "No/Not satisfied" or "Partially satisfied", please explain why?

_____

_____

_____

1.8 Are you familiar with the EU principles and standards for environmental protection?

☐ Yes	☐ No	☐ Partially

1.9 Are you familiar with the EU principles and standards for water resource protection (Water Framework Directive – WFD)?

☐ Yes	☐ No	☐ Partially

1.10 Are you familiar with (have heard of) the fact that Lake Ohrid is a habitat (home) to a number of endemic species (animal species that live only in Lake Ohrid and nowhere else in the World)?

☐ Yes	☐ No	☐ Partially

1.11 According to your opinion, are the endemism and biodiversity of Lake Ohrid values of essential importance?

☐ Fully disagree	☐ Disagree	☐ No opinion	☐ Agree	☐ Fully agree

1.12 According to your opinion and based on presumed intensity of the negative effect, please rank listed pressures on the quality of the water in Lake Ohrid and the entire watershed, as well as on the biodiversity supporting the basin:

Pressures/Rank	**Minor (No) effect**	**Medium effect**	**Strong effect**
Discharge of untreated wastewater (sewage) into the lake			
Obsolete (not fully functional) sewage collecting system			
Large number of tourist accommodation and hospitality facilities around the lake			
Large number of individual recreational facilities (weekend/holiday houses)			
Inappropriate urbanization – construction density at certain localities			
Large number of boats/vessels in the lake – emission of hazardous substances in the water			
Large number of tourists during the summer season			
Inappropriate lake shorezone management (beaches)			
Unsustainable (intense) fishing			
Introduced invasive alien species in the lake			
Inappropriate solid waste management around the lake (illegal dumps)			
Surface runoff from agricultural land			
Inappropriate management of protected areas and forests in the basin			
Inappropriate and obsolete transport infrastructure			
Climate change			
Other, please list and rank:			

1.13 According to your opinion, which stakeholder (user) do you think will have the largest benefit from maintenance of good water quality in Lake Ohrid? Please rank listed stakeholders from 1 (lowest) to 5 (highest) benefit.

☐ Households (local population) _____

☐ Tourist facilities (resorts) _____

☐ Businesses (small and medium enterprises and individual entrepreneurs) linked with tourism (e.g. accommodation, boating, fishermen...) _____

☐ Local industry _____

☐ Other, please state and rank: _____

1.14 Which institution do you think holds prime responsibility for maintenance of good water quality in the lake? Please rank listed institutions from 1 (lowest responsibility) to 5 (highest responsibility).

☐ Municipalities and public communal enterprises around the lake _____

☐ Regional government units (centers) _____

☐ The central government (responsible ministries and agencies) _____

☐ Other, please state and rank: _____

1.15 Which institution do you think at present contributes the most for maintenance of good water quality in the lake? Please rank listed institutions from 1 (lowest contribution) to 5 (highest contribution).

☐ Municipalities and public communal enterprises around the lake _____

☐ Regional government units (centers) _____

☐ The central government (responsible ministries and agencies) _____

☐ Other, please state and rank: _____

Part 2. Contingent Valuation of Lake Ohrid Watershed

The responsible state institutions for environmental protection, in coordination with the local self-governments from the Ohrid region, intend to establish a multi-year program for integrated management of water resources in Lake Ohrid's watershed, in compliance with the EU standards (WFD). Suppose that a special voluntary "Fund for protection and promotion of water resource and biodiversity in the Lake Ohrid basin" is planned to be established for the purpose. Fund's resources will be used for development of policies and financing of concrete infrastructure projects aimed at improving the overall conditions in the Lake Ohrid basin.

2.1 Would you be willing to contribute resources from your household budget for annual payments in the Fund?

☐ Yes	☐ No

2.2 If your answer to the previous question is YES, how much are you prepared to pay in the Fund annually?

☐ Up to €10	☐ €10 – €15	☐ €15 – €35	☐ €35 – €50
☐ €50 – €80	☐ €80 – €165	☐ €165 – €325	☐ Above €325

2.3 If your answer to question 2.1 is YES, which is the prime reason (please check only the most important answer)?

☐ Lake Ohrid has a special value for me	☐ Lake Ohrid has a special value for my family	☐ Lake Ohrid has a special value for the society
☐ Lake Ohrid is important for future generations	☐ The resources of Lake Ohrid region are irreplaceable/essential	☐ It is necessary to protect the natural resources of Lake Ohrid
☐ Other, please explain: _____ _____		

2.4 If your answer to question 2.1 is NO, which is the prime reason (please check only the most important answer)?

☐ Lake Ohrid is not important to me	☐ Lake Ohrid is not important for my family	☐ Lake Ohrid has no special value for the society
☐ Lake Ohrid is not important for future generations	☐ Other regions in the country are priority	☐ There is no need to protect natural resources of Lake Ohrid
☐ Only state organizations/agencies should pay for the protection		
☐ Other, please explain: _____ _____		

Part 3: Basic information

Please provide your basic demographic information:

3.1 Gender ☐ Female ☐ Male

3.2 Age _____

3.3 Place of residence _____

3.4 Education

☐ Primary	☐ Secondary	☐ Higher – 1st degree	☐ Higher (University)	☐ Post-graduate

3.5 Employment/occupation

☐ Student	☐ Full-time employed	☐ Part-time employed	☐ Unemployed	☐ Retired

3.6 Total household/family monthly earnings

☐ Up to €350	☐ €350 – €650	☐ €650 – €1,000	☐ €1,000 – €1,650	☐ Above €1,650

3.7 Are you an active member of an environmental organization?

☐ Yes	☐ No

3.8 Have you donated for environmental protection purposes in the last two years?

☐ Yes	☐ No

3.9 Are you an active member of any other kind of humanitarian/development organization?

☐ Yes	☐ No

3.10 Have you donated for humanitarian/development activity in the last two years?

☐ Yes	☐ No

The Survey is anonymous. Please do not sign the Questionnaire!

Appendix 4: Major Cultural Heritage Sites in the North Macedonia part of the Lake Ohrid Watershed[29]

Site Name	Type/period
Prehistoric Sites	
Vranishta, *Crkveni Livadi*, Struga	Neolithic/Eneolithic period
Mouth of Drin River, Struga	Neolithic/Eneolithic period
Dolno Trnovo, Ohrid	Neolithic period
Gorno Sredoreche, *Zlastrana*, Ohrid	Neolithic period
Vranishta, *Crkveni Livadi*, Struga	Bronze age
Gorenci, *Tri Chelusti*, Ohrid	Iron age
Rechica, *Lozhishta*, Ohrid	Iron age
Antique Sites	
Ohrid, *Gabavski Rid* – St Erazmus	Pre-Roman town/fortress
Ohrid, *Gorni Saraj* (Hellenic Lychnidos)	Pre-Roman town/fortress
Lychnidos – Ohrid (Old part of the town)	Roman town
Delogozhdi, *Sv. Ilija*, Struga	Pre-Roman necropolis
Opejnca, Ohrid	Pre-Roman necropolis
Trebenishte, Ohrid	Pre-Roman necropolis
Ohrid, *Deboj*	Pre-Roman necropolis
Oktisi, Struga	Significant Early-Christian basilica
Radolishta, Struga	Significant Early-Christian basilica
Mediaeval Cultural Monuments	
Ohrid, Old part of present-day Ohrid	Mediaeval town
Velestovo, Ohrid	Mediaeval church/monastery
Kalishta, Struga, St. Athanasius	Mediaeval church/monastery
Ohrid, The Archangels Gabriel and Michael(St. Nahum's Monastery)	Mediaeval church/monastery
Ohrid, The Holy Mother of God Bolnichka	Mediaeval church/monastery
Ohrid, The Holy Mother of God Peribleptos (St. Clement)	Mediaeval church/monastery
Ohrid, The Holy Mother of God Chelnica	Mediaeval church/monastery
Ohrid, The Physician Saints (Miraculous Healers: Anargyroi)	Mediaeval church/monastery
Ohrid, St. Demetrius	Mediaeval church/monastery
Ohrid, Cave Church of St. Erasmus	Mediaeval church/monastery
Ohrid, St. John the Divine at Kaneo	Mediaeval church/monastery
Ohrid, Ss. Constantine and Helena	Mediaeval church/monastery
Ohrid, St. Nicholas Bolnichki	Mediaeval church/monastery
Ohrid, St. Pantelejmon (Clement's Monastery at Imaret)	Mediaeval church/monastery
Ohrid, St. Sophia	Mediaeval church/monastery
Ohrid, Cave Church at St. Stephen	Mediaeval church/monastery
Radozhda, Struga, The Cave Church of Archangel Michael	Mediaeval church/monastery
Trpejca, Ohrid, The Holy Mother of God of Zahum (Zahum Monastery)	Mediaeval church/monastery
Leskoec, Ohrid, The Ascension of Christ	Mediaeval church/monastery
Ohrid, Imaret Mosque	Mediaeval Islamic edifice
19-th Century Cultural Monuments	
Ohrid, The Holy Mother of God of Kamensko (Sveta Bogorodica Kamensko)	Church/monastery
Ohrid, The Physician Saints (Sveti Vrachi)	Church/monastery
Ohrid, St. Nicholas of Gerakomia (Sveti Nikola Gerakomija)	Church/monastery
Struga, St. George (Sveti Georgija)	Church/monastery
Ohrid, The Holy Mother of God of Kamensko (Sveta Bogorodica Kamensko)	Iconostas
Ohrid, The Holy Mother of God of the Hospitals (Sveta Bogorodica Bolnichka)	Iconostas

[29] Source: North Macedonia Cultural Heritage (1995).

LOWMP Supplement III
Agriculture – Diffuse, Abstractions, Other Pressure Types

Introduction

Unsustainable practices in agriculture production and forest management can cause serious pressures on natural resources, especially soil and water, affecting its ecosystem services.

In general, the agriculture causes a diffuse (nonpoint) pollution of aboveground and belowground water bodies with nutrients, sterile sediment, solid waste and organic polluters and organic by-products. In some cases, inappropriate management of forests, especially sitations of clear cut on sloppy terrains, can seriously affects oil resources and hydrological conditions in the catchment area, causing appearance of surface run-off, soil erosion and production of sediment which have a direct influence of water resources.

The quantification of the diffuse pollution is a complicated task due to the fact that there are many sources of pollution, involved stakeholders with different habits and interests making the process of estimation of diffuse pollution a very complicated task, involving various side effects, transformations, movements and interactions. For these reasons there is still not a simple and reliable approach in the quantification of the diffuse pollution, which will give a good ground for quantification of the pollution, monitoring, design and implementation of measures for mitigation and assessment of its effect on a long run.

The Lake Ohrid watershed is situated on the border between North Macedonia and Albania and falls within the territory of 4 municipalities: Debarca, Ohrid and Struga from the North Macedonia side and Pogradec in Albania. The total area of the four municipalities is 149,323 ha, out of which 104,378 ha are within catchment area. According the LPIS data[1] for the North Macedonia side and Statistical data for Albanian part and additional graphical data sets, like: CORINE Land Cover (2012) and Setniten satellite

Table 1. Land use data in Ohrid Lake catchment

Water Body	Total area (ha)	Agricultural land (ha)	% of agricultural land	Forest and forest land (ha)	% of forest and forest land	Other land	% of other land
Cerave	1656,9	494,2	74,1	2456,6	782,6	782,6	104,2
Kalishta	119,3	80,1	103,1	1443,5	2,2	2,2	49,1
Koselska-1	13,2	779,7	84,5	2383,2	48,9	48,9	0
Koselska-2	1359,6	1533,1	1704	7488,8	65,8	65,8	73
Lin	230,1	34,6	33,7	455,7	518,1	518,1	5,4
Radozhda	24,5	23,8	0.0	215	7,8	7,8	77,7
Sateska-1	2078,9	4844,1	2280,1	19451,4	329,7	329,7	110,9
Sateska-2	645	293,4	215,2	2642,7	0.0	0	53,8
Sateska-3	1019	247,2	0.0	719,9	0.0	0	109,1
StrugaDrim	376,7	118,8	3,1	447,6	0.0	0	138,8
StudKanal	55,4	67,3	0.0	0	34,6	34,6	346
Sushica	793,7	1578,5	223,4	766,4	56,8	56,8	512,4
Velidab	204	4872,6	536,7	3558,6	19	19	107,5
Podgradec	1093,8	516,3	0,2	2237,2	96,7	96,7	612,6
Udenisht	290,8	53,1	54,9	1535,5	148	148	241,1

images (2018), the total area of agricultural land (arable land+pastures) is estimated to 25,497 ha, while the forest and forest land is estimated to a total area of 47,912 ha. The remaining area that is not identified

[1] Land Parcel Identification System.

within these categories is summed up within the category Other land and encompasses areas designated as mixed land classes and unproductive industrial sites, infrastructural objects, bare land, wetlands and water bodies, etc.

Methodology

For quantification of the diffuse pollution from agriculture, various sources of data have been used in order to quantify the pressures.

All calculations were performed on the level of the previously delineated Water bodies (WB). The total number of delineated water bodies within the basin affected with pressures aroused from agriculture, are 15 from the both sides of the border.

For estimation of the land use, for the North Macedonia part, data from the Land Parcel Identification System (LPIS, 2018), were used. This data source enables detailed graphical presentation of the land use in the catchment area. Giving though that in all cases the territory of the municipalities, except the municipality of Struga, almost perfectly overlaps with the territory of the delineated water bodies, data from the State Statistical Office and the Regional Office of the Ministry of Agriculture, Forestry and Water Economy, related to the land use were used as auxiliary data source.

For the identification of agricultural land on Albanian side of the catchment area, data from the Regional office of MARD in Korcha were used, and additionally verified with a field visit, and Sentinel 2 satellite image (10 m) from the vegetation period of 2018.

On the base of the graphical data sets and available statistical data, agricultural area is divided into 6 categories of land use Table 2, while the first category: field crops is additionally subdivided into 5 sub-categories (cereals, industrial crops, vegetables, forage crops and glasshouses). This classification has been made on the base of similarity of the inputs needs and management practices applied for each category and to this end, the extent of pressures on the environment.

In order to have better general overview of the current land use and management practices in the catchment area and to perform a ground verification of the satellite image, four field visits were performed and 16 preselected sites were visited. During this visits additional points were recorded with a GPS from a various land use types in the catchment area. In order to collect information related to the common agricultural practices, an exhaustive questioner has been prepared and used to interview a group of more than 15 farmers from different parts of the catchment area.

During the reporting period, a historical data has been collected too, which gave a valuable information related to the agricultural practices in the catchment, like: data from a previously conducted questionery campaigns, data from the retailers of agro-chemicals in the region for the total quantity of sold fertilizers and pesticides, etc.

Agriculture

In general, the pressures from agriculture arouses from several unsustainable practices, like:

- Inappropriate management of agricultural areas with: overuse of agricultural land, mono-cropping, unsuitable irrigation practices and application of excessive quantities of agrochemicals (fertilizers and pesticides) which cause pollution of groundwater with nitrogen and organic polluters,

- Inappropriate cultivation practices which provoke destruction of soil structure and cause intensive processes of soil erosion which leads to surface runoff and pollution of surface water with phosphates, heavy metals and sterile sediment,
- Unsustainable manure management especially its collection and storage, manipulation and application, which can cause serious pollution of surface and ground water resources and
- Overgrazing of pastures which causes degradation of vegetation and soil structure, causing a serious processes of soil erosion and soil compaction

Land use and cropping pattern

Agricultural production in the basin is organized within small households. Out of the whole number of households in the Southwestern region in North Macedonia, more than 72% are smaller than 1 ha, while more than 95% are up to 3 ha, divided into several parcels with average size less than 0.1-0.2 ha. Statistical data, for Albania reveals similar trends, regarding the farm and parcel size. Most of the production is for self-consumption or for green markets during the touristic season.

Taking in consideration the identified land use types and areas under certain land use type, the intensity of agricultural production and location, it can be concluded that there is a significant differences in the intensity of pressure from agriculture within each of the WB on water resources. To this end, water bodies in the catchment area can be categorized in four groups, as follows:

1. Water bodies with small agricultural areas and dominance of low intensity field crop production and natural vegetation, distant from the Ohrid Lake or its tributaries, like: Koselska A.
2. Second group of water bodies are those with significant areas of agricultural land distant from Lake Ohrid but close to one of its tributaries, like: Sateska-1 and B on North Macedonia side and Cherave WB on Albanian side.
3. The third group of water bodies are those with small areas of low intensity agricultural production that are close to Lake Ohrid, like: Velidab, Studenchiski kanal, Kalishta, Radozda, Lin and Undenisht, and
4. The fourth group of water bodies who have heavy influence on water resources due to big areas of intensive agricultural production, like: Pogradec, HM Sateska-3, Koselska-2, Sushica, StrugaDrim and Lin.

Table 2. Land use on WB level in Ohrid Lake catchment

WB	Field crops						Orchards	Perennial plantations	Mixed per. plantations	Vineyards	Pastures	TOTAL
		cereals	industrial crops	vegetables	forage crops	glasshouses						
Cerave	1370,54	977,79	103,50	245,40	43,85	0,04	161,99	16,58	0,75	106,98	494,18	**2151,06**
Kalishta	118,38	88,18	0,00	13,10	17,10	0,00	0,12	0,41	0,34	0,00	80,14	**199,39**
Koselska-1	12,64	12,64	0,00	0,00	0,00	0,00	0,59	0,00	0,00	0,00	779,73	**792,96**
Koselska-2	943,03	447,47	58,46	183,70	253,40	1,91	315,34	28,14	0,87	70,33	1533,12	**2892,74**
Lin	204,87	153,41	14,08	33,38	4,01	0,00	13,12	0,00	0,00	12,15	34,55	**264,70**
Radozhda	21,48	13,19	0,62	4,46	3,21	0,00	0,67	0,78	0,00	1,62	23,81	**48,36**
Sateska-1	2054,42	1037,95	257,37	344,30	414,80	0,07	14,61	9,37	0,00	0,38	4844,05	**6922,90**
Sateska-2	429,25	225,05	29,80	114,00	60,40	0,09	91,43	17,67	0,00	106,55	293,41	**938,39**
Sateska-3	810,39	488,80	22,83	210,50	88,26	0,45	153,48	18,53	1,06	35,09	247,20	**1266,19**
StrugaDrim	345,79	297,80	0,00	16,13	31,86	0,61	23,83	5,62	0,39	0,47	118,77	**495,48**
StudKanal	32,24	27,40	0,00	0,00	4,84	6,09	4,13	3,67	0,00	9,27	67,25	**122,64**
Sushica	538,37	202,37	39,90	142,60	153,50	2,84	184,53	41,49	2,23	24,29	1578,51	**2372,25**
Velidab	137,94	95,50	16,64	14,00	11,80	0,00	4,59	39,84	1,18	20,42	4872,64	**5076,62**
Podgradec	950,14	680,91	72,34	171,53	25,36	2,35	67,44	11,45	0,00	62,44	516,31	**1610,13**
Udenisht	256,29	180,95	19,22	45,58	10,54	0,00	17,92	0,00	0,00	16,59	53,10	**343,91**
TOTAL	**8225,78**	**4929,41**	**634,76**	**1538,68**	**1122,93**	**14,45**	**1053,78**	**193,55**	**6,82**	**466,57**	**15536,77**	**25497,71**

Out of the data presented in Table 2, it can be seen that total agricultural land in the Ohrid catchment is close to a 25,497 ha (including pastures), while the arable land is 9,960 ha, or 31.9% of total area. In some WB, like Koselska A (98.3%) and Velidab (96%), the category of pastures prevails over arable land. This is important to note, since except of animal grazing, there are very low inputs of nutrients or any other managing practice.

Within the arable land, the category of field crops covers the majority of the agricultural land with more than 8,225 ha (92.6%). According the available data presented in Tab. 2 and performed field visits, most of the area under field crops are sown with cereals: wheat and maize, encompassing 49.5% of arable land, and small areas of forage crops (11.3%) and industrial crops. This means, that a significant part of this category is under extensive, low input systems of agricultural production. The majority of the arable area sown with cereals is within 3 water bodies: Cherave, Sateska A and Pogradec (Picture 1, Annex 1). Industrial crops, covers a small area of 6.4% of the arable land (635 ha). Industrial crops are represented with tobacco on 430 ha and potatoes on 235 ha (Picture 2). Although industrial crops are generally highly intensive crops, the fact that tobacco is the dominant plant type which is usually cultivated on remotely hilly regions give us a ground to conclude that the industrial cops are not a significant source of pressure. Tobacco plant is usually cultivated with low nutrients inputs in order to preserve the balance of yield vs. quality. Soils where this two industrial plants are cultivated are usually dressed with manure every 4-5 years with higher inputs of potassium fertilizers.

Forage crops covers a total area of 1,123 ha. Most dominant crop types are alfalfa (819.2 ha) and clover (140.8 ha) (Picture 3). Most part of the area under clover is distributed in Sateska-1, B and C and alfalfa in Koselska-2 and Sushica. Areas under forage crops within the other WB are insignificant. Forage crops are manly cultivated for hay production as animal feed or as a cover crops for mulching of the former orchards or vineyard plantations. Except irrigation and moving in most cases there are very low inputs of nutrient and pesticides.

Vegetables is estimated on approx. 1,540 ha (15.4) of the arable land. The dominant crops within the vegetables are beans and onion. Area of this category is usually mixed with other categories, or in many cases vegetables are planted within the house yards in the villages, like: potato, cabbage, peppers, tomatoes and beans. There is a more significant and organized production of beans in the Cherave, Pogradec and Sateska-3 WB. Vegetable production a high intensity agricultural production with significant inputs of nutrients, and pesticides and with high water demand. For these reasons although the vegetable areas are scattered over the catchment area, still, particular attention has to be placed to areas near lake shore or tributaries. The total area of greenhouses in the catchment area is negligible except a one location of almost 6 ha of glasshouse in Studenchishki_kanal water body, which can be considered as a possible source of pollution.

Land use categories like: orchards, vineyards and perennial and mixed perennial plantations, are more intensive systems of agricultural production with higher inputs of fertilizers and pesticides (Picture 4). The majority of areas within these land use types which covers 1,721 ha (17.3%) of the arable land of the catchment area, are mainly distributed in the Koselaska_2 and HM Sateska 2 and 3, Drim_Struga, Sushica and Cherave and Pogradec WB. Areas under category of land use, having in mind the intensity of the production and inputs, if is situated close to the lake shore or lake tributaries, can be designated as a zones with high risk on water resources. In the past decade on both sides of the border a new intensive plantations of cherries, apples, nuts and pears were established, which results in increasing of nutrients and other agro-chemicals in the catchment area.

The rest of the agricultural land are under pastures, which covers 15,537 ha (60.9%). Areas within this land use category is mainly covered with meadows, permanent grass or natural pastures. This category

of land use have a very limited human attention, due to what cannot be considered as areas with potential risk of diffuse pollution.

Table 3. Land cover of the catchment area (CORINE Land Cover)

WB	Arable land	Pastures	Lpoa&sanv*	Forest	Natural Grassland	Forest land and rangeland	Other
Cerave	1656,9	494,2	74,1	2456,6	782,6	782,6	104,2
Kalishta	119,3	80,1	103,1	1443,5	2,2	2,2	49,1
Koselska-1	13,2	779,7	84,5	2383,2	48,9	48,9	0,0
Koselska-2	1359,6	1533,1	1704,0	7488,8	65,8	65,8	73,0
Lin	230,1	34,6	33,7	455,7	518,1	518,1	5,4
Podgradec	1093,8	516,3	0,2	2237,2	96,7	96,7	612,6
Radozhda	24,5	23,8	0.0	215,0	7,8	7,8	77,7
Sateska-1	2078,9	4844,1	2280,1	19451,4	329,7	329,7	110,9
Sateska-2	645,0	293,4	215,2	2642,7	0.0	0,0	53,8
Sateska-3	1019,0	247,2	0.0	719,9	0.0	0,0	109,1
StrugaDrim	376,7	118,8	3,1	447,6	0.0	0,0	138,8
StudKanal	55,4	67,3	0.0	0,0	34,6	34,6	346,0
Sushica	793,7	1578,5	223,4	766,4	56,8	56,8	512,4
Udenisht	290,8	53,1	54,9	1535,5	148,0	148,0	241,1
Velidab	204,0	4872,6	536,7	3558,6	19,0	19,0	107,5
TOTAL	**9961,0**	**15536,8**	**5313,0**	**45802,3**	**2110,3**	**2110,3**	**2541,4**

*Land principally occupied by agriculture, with significant areas of natural vegetation

In order to have an exhaustive overview of the land cover in the catchment area in addition to the previously mentioned data sources, CORINE land Cover (2012) was used as an auxiliary data set. Twenty two CORINE land cover classes which are present in this catchment (Level 3), for a better overview were regrouped into 7 classes, as indicated in Tab. 3 (pastures and agricultural land is sourced from other datasets). In order to have as much as possible estimation CORINE data set was fine-tuned over high resolution ortho-photos and Sentinel images.

1. **Agricultural land** and Pastures are estimated on the base as previously mentioned on the base of data extracted from LPis (Land Parcel Identification System), State Statistical Office Data and auxiliary graphical data sets (Sentinel2, ortho-photos).
2. **Forest land** – consists of 3 classes related to forest species (Broad-leaved forest, Coniferous forest and Mixed forest)
3. **Forest land and rangeland** - consists of 4 classes related to sparsely vegetated areas and heathland (Moors and heathland, Sclerophyllous vegetation, Transitional woodland-shrubs, Sparsely vegetated areas
4. **Other** – sums up all other un-vegetated areas and marshes (Discontinuous urban fabric, Inland marshes, Water bodies)

Out of the data present in Tab. 3, it can be seen that all classes of agricultural land (arable + pastures) yields a total area of almost 25,498.

In terms of the other categories, forests in the catchment area covers more than 45,700 ha and is the dominant type of land cover. Among the water bodies, the majority of areas under forests are situated into 2 water bodies: Koselska_2 with 16,87% and Sateska_1 with 43,24%, which is in total more than 60% of the forest resources in the Ohrid catchment. It should be noted that out of the total of forest

land, almost 42,26% or 92,44% is broad leaf forests. In order to have as much as possible precise information about the areas under forest, CORINE land cover was additionally fine-tuned over existing high resolution graphical data sets (orthophoto images for North Macedonia part and Sentinel satellite image for Albanian part).

Mineral fertilizers and pesticides use

Fertilizers and pesticides have a long history of use in the world and are considered important components of modern farming. Their use in agriculture is a prerequisite for sustainable production in terms of yields and quality of the agricultural products. For these reasons, its usage especially in the modern and intensive systems of production is unavoidable practice.

Depending on the area of agricultural land threaded and its vicinity to water resources, this inputs of high quantities of agro-chemicals, especially if used without plans and programs for its use (fertilization and plant protection plans), on a long run can cause contamination of soil and ground and surface water. Surface run-off after produce soil sediments rich with nutrients, which if reach surface water bodies, will cause its pollution and eutrophication. On the other side, nitrogen used in agriculture, with leaching through soil profile, can cause contamination of ground water with nitrates.

In addition, this excessive quantities of mineral nutrients can have negative impacts on the soil production potential and agro-biodiversity, as well as negative economic impacts for the producers. The issue of optimization of fertilizers and pesticides use in agricultural production is particularly important in areas close to a protected areas and big aquifers like Ohrid Lake which are of particular interest for the community and a considered as monuments of the nature.

In order to estimate the base line conditions in the area, and to evaluate the quantities of applied fertilizers and pesticides, the agricultural land use per water body, was used as a base for estimation. The quantities used for each type of land use were estimated on the base of previous investigations (Dimitrovska Radevska, B. 2014) and field visits data.

Mineral fertilizers

Sustainable management of nutrients in agricultural systems is critical for sufficient production of nutritious foods and to minimize environmental pollution. Fertilizer is considered one of the main inputs for increasing crop yields and farm profit. Today, fertilizers are available in many forms, and are widely used to aid plant growth and increase crop production.

The three broad categories of fertilizers are nitrogen, phosphorus, and potassium (NPK). They are crucial for plant growth, development, function, and reproduction. Applying these inputs correctly is critical for the success of the crop producer and the health of the consumer and the environment.

According our investigations in the catchment area, the most frequently used fertilizers are: NPK (15-15-15 and 8-16-24), for a base dressing of soils and KAN or NH4NO3 for nitrogen application during the vegetation period. The quantities of fertilizers used are very difficult to estimate since in both countries there is not an official data source for the import, trade and on site use of fertilizers and pesticides. The only source of information is a direct contact with the producers, but even this direct approach has its limitations. Namely, in many cases producers give a rough estimate, which are significantly variable, in many cases they do not keep a records for fertilizers or pesticides applied, the accuracy of data depends to the method of application, etc. For instance, if applied manually by hand around the plan/three it is very difficult to estimate the right quantities per surface area.

Most fertilizer recommendations for crop producers are based on their own experience. For these reasons, and many other factors, field collected data need additional expertise in order to draw with as much as possible right conclusions.

Generally speaking, the maximum amount of applied quantities of mineral fertilizers in orchards are approx. 500 kg/ha, in vineyards between 300 and 400 kg/ha and in field crops with 250-300 kg/ha. Estimation of the total fertilizers needs in the catchment area, have been made based on the areas under certain crop type per water body and its needs for certain yield. The estimation of the actually applied fertilizers, were performed on the base of filed data and the expert judgement coupled with land use data, were used. Retention of nutrients, per WB is a differences between the actually applied fertilizers and plant needs.

Table 4 Quantities of mineral fertilizers and pesticides applied

Water bodies	Total area	Treated area	Quantity of applied fertilizers	MINERAL FERTILIZERS						PESTICIDES	
				total quantity of nutrient applied			total quantity of retention			Treated area	Quantity of applied pesticides
				active matter, t			active matter, t				
	ha	ha		N	P	K	N	P	K	ha	
Sateska A	6922,9	2078,8	658,1	125,7	68,8	76,9	28,8	16,8	-40,3	1340,9	3370,8
Sateska B	938,4	645,0	232,3	42,2	25,3	31,3	7,5	10,7	-13,8	517,1	4853,2
HM Sateska C	1266,2	1019,0	399,3	73,6	42,8	51,4	21,7	19,2	-8,1	800,9	5363,8
Koselska A	793,0	13,2	13,2	4,6	0,9	0,5	0,1	0,1	-0,2	9,5	29,7
Koselska B	2892,7	1359,6	632,1	119,7	65,1	81,6	27,3	23,7	-50,9	982,4	9324,6
Stud.kanal	122,6	55,4	23,1	4,1	2,5	3,2	0,3	1,0	-1,6	43,6	363,7
Susica	2372,3	793,7	284,1	47,9	33,7	42,6	8,3	14,2	-15,6	584,2	5422,3
Velidab	5076,6	204,0	80,4	14,6	8,8	10,8	1,8	3,6	-5,3	162,5	1117,4
Kalishta	199,4	119,3	41,6	8,1	4,5	4,6	1,3	1,2	-1,7	79,2	179,7
Struga Drim	495,5	376,7	153,4	31,0	15,1	16,5	6,9	4,5	-5,6	270,7	1043,6
Radozda	48,4	24,5	8,7	1,6	0,9	1,1	0,1	0,2	-0,7	17,8	87,6
Cherave	2151,1	1656,9	748,0	154,6	74,0	86,4	24,3	15,4	-50,6	1324,0	7873,4
Lin	264,7	230,1	99,7	20,7	9,8	11,2	1,3	1,4	-7,7	181,2	850,8
Pogardec	1610,1	1093,8	460,0	93,1	44,8	51,6	4,9	5,4	-39,0	867,2	4337,5
Udenisht	343,9	290,8	124,7	25,5	12,5	14,3	1,4	1,1	-10,8	226,8	1120,4
TOTAL	**25497,7**	**9960,9**	**3958,9**	**767,1**	**409,6**	**484,0**	**136,0**	**118,4**	**-251,7**	**7408,1**	**45338,5**

Out of the data presented in Table 4 it can be seen that the total treated area with fertilizers is estimated on 9960.94 ha, which is less than 50% of the total agricultural area (25497.11 ha), the assumption is that according filed data, the class of pastures is not treated with fertilizes at all. For this reason certain WB like (Sateska_1, Koselska_2, Susica and Velidab) although with high agricultural area have a low amount of applied fertilizers and treated area.

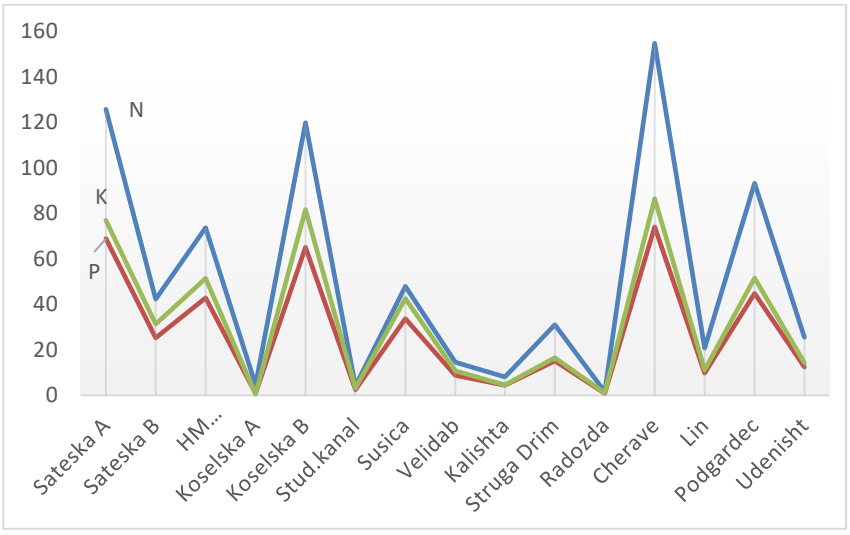
The total estimated quantities of applied fertilizers is 3,950 t/year with average input of 0.4 t/year of mineral fertilizers per hectare in one vegetation season. This figure is quite realistic having in mind that producers in average, usually applies around 200-300 kg/ha as a basic dressing with optional additional input of 100-150 kg/ha of nitrogen fertilizer in spring. The only constraint in this estimation is the fact that one part of the identified agricultural land is abandoned, but still it cannot significantly influence the final quantities of applied fertilizers.

The distribution of fertilizer quantities per water body depends to the total agricultural area and the structure of land use types (Table 4). Thus, water bodies with highest fertilizers inputs are Koselska-2 (632.10 t/year) and Sateska-1 (564.98 t/year) on North Macedonian side and Cherave (647.40 t/year) on Albanian side. This higher amounts of applied fertilizers is also result to the bigger areas under orchards and vineyards, where farmers usually apply high doses of fertilizers.

In HM Sateska-3 and Podgradec WB, the higher amount of fertilizer input (approx..400 t/year) is due to the presence of big areas of field crops, especially maize and vegetables, and orchards in the case of HM Sateska-3, where farmers usually apply higher quantities of mineral fertilizers per year.

Other water bodies have less than 200 t/year of applied fertilizers, which vary in a very broad ranges, depending on the total arable land and crop structure. Koselska_1 and Radozda WB have the lowest inputs of fertilizers, in a quantity of 13.23t/ha and 8.74t/ha, respectively. Most of the agricultural land in this water bodies is occupied with pastures, with a small area of arable land, primarily field crops.

Graph 1. Quantities of nutrients applied, t/year



In some cases, where high intensity agricultural production is close to the lake shore or its tributaries, these areas could be designated as a hot spots of diffuse pollution with nutrients and pesticides. Such cases were identified within several WB, like: HM_Sateska_3 where intensive orchard production is performed close to lake, Koselska_2 where high intensive orchards (more than 315 ha) causes a high pressure on Koselska river. Similar situation was noted with WB Cherave as well, where a high intensity

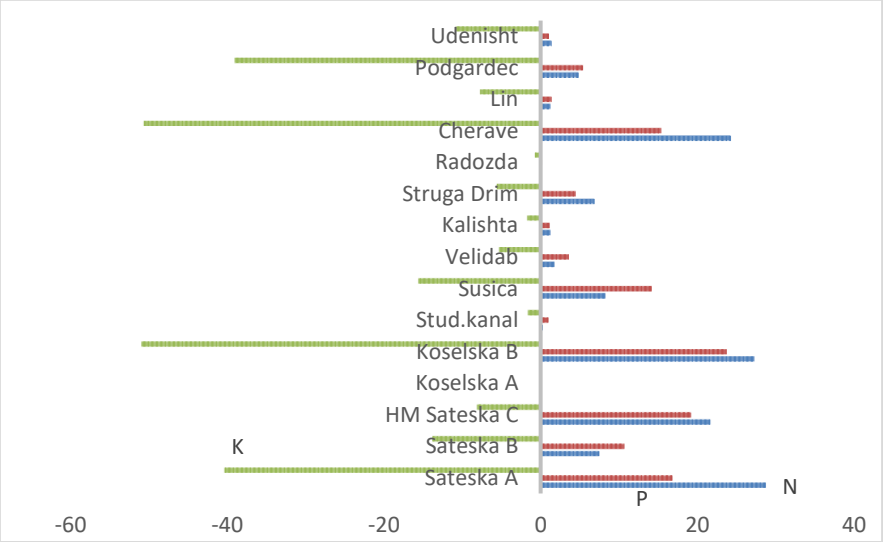
vegetable production and orchards are spread over 245.4 and 62 ha, respectively, causing serious pressure on Cherave river. Water bodies Pogradec, with highly intensive vegetable production close to the lake shore and Studenciski kanal, Velidab. In order to mitigate the pressure in such cases, the provisions of Nitrate directive provision, should be firmly implemented in place.

Total quantity of applied and accumulated nitrogen, phosphorus and potassium from mineral fertilizers is presented in Table 4. A high quantity of more than 100 t of nitrogen, is applied in some WB with intensive agricultural production or with big areas of arable land, like: Sateska_1, Koselska_2 and Cherave. The quantity of the other two nutrients, potassium and phosphorus, are similarly distributed (Graph 1) and vary in a broad ranges of 0.9 and 0.5 t/year for P2O5 and K2O, in Koselska-1, up to 74.0 t/year of P2O5 and 86.4 t/year in Cherave WB. The similarity in the quantities P2O5 and K2O applied, are result to the even quantities of these elements within the usually applied PK formulations.

The total nitrogen load is estimated on 766.9 t, while the phosphorus and potassium loads are estimated on 409.6 and 484.1 t, respectively.

Similar relationship [2:1] can be observed between soil nitrogen and phosphorus accumulation. This is also a consequence to the ratio of this two elements within the commonly used NPK formulations. Usually, farmers use fertilizers which do not respond to the needs of plants, mining that in some cases applies excessive quantities of one nutrient, while the other one is in shortage. This biased quantity of applied fertilizers are important to know, as a prerequisite for optimization of fertilizers inputs in the catchment Data presented in Tab. 4 showed that within all analyzed water bodies, deficit of potassium in the soil is notable (Graph 2). Based on the data gathered during the field visits and our expertise, generally this deficit is result of several factors, like: low availability of potassium in the soil, applying of formulations with low percent of K, high potassium needs of some plants, like tobacco, potatoes, maize, etc.

Graph 2. Retention of mineral fertilizers in the catchment



The retention of nutrients as previously mentioned, is result of the excessive quantities or biased application of fertilizers. According the data presented in Tab. 4, the yearly accumulation of nitrogen in the catchment area yields 135.96 t N and 118.45 t/year of phosphorus, while potassium is in deficit of more than 252 t/year, mining that this element is amended from the natural soil abundance. Out of the data presented in Tab. 4 it can be concluded that the highest quantities of retention are in

Sateska_1, Sateska_3 and Koselska_2, WB on North Macedonia part of the catchment, and Cherave WB on Albanian side, with over 20 t N and 15 t P2O5 accumulated in the soil. Such high quantities of accumulated nutrients every year are alarming, and emphasizes the need of sound and concrete action for optimization of fertilizers use, since nutrient pollution might have a serious negative impact on the aquatic environment. Too much nitrogen and phosphorous in the water causes algae to grow faster than ecosystems can handle. In addition, this excessive use of mineral fertilizers, especially inorganic nitrogen leads to acidification of soil and contaminate the agricultural soil, also known as agrochemical pollution.

Water (surface and ground water) contamination, chemical crops burn wih inappropriate use, increased air pollution, acidification of soil and mineral depletion of soil are the adverse effects of excessive inputs of mineral fertilizers.

Pesticides

Pesticides are agro chemicals for control weeds and pest control which pose a threat to crop production. In modern and intensive agricultural systems, the use of pesticides is indispensable, since if left unchecked. weeds can quickly outcompete the crop for essential light. water. and nutrients. Many kinds of insects feed on crops. damaging plants and limiting production. At the beginning pesticides were considered as a quick and easy inexpensive solution for controlling weeds and pests, but with application of these chemical on a long run some essential problems appear. Its bioaccumulation in the food chain can eventually become a risk to whole nature, because pesticides have contaminated almost every part of our environment.

Pesticide use raises a number of environmental concerns and human and animal health hazards. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species including non-target species air water and soil.

Pesticides similarly like nutrients can reach surface water through runoff from treated areas or with leaching through the soil profile, down to the ground water level. Unfortunately these chemicals in most cases, are non-biodegradable, persistent and get accumulated in the environment and thus into the human food chain.

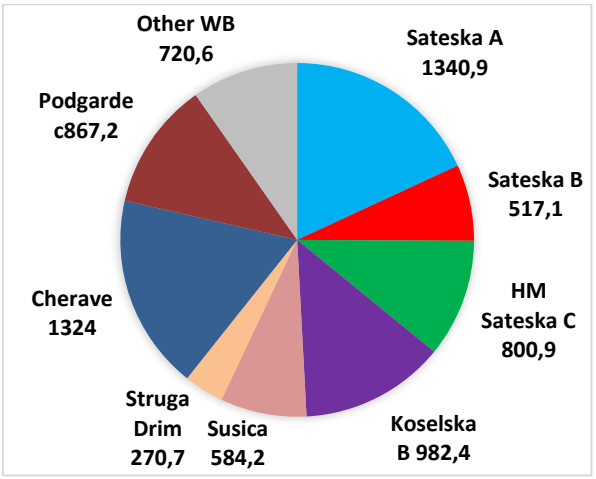
General conclusions drown out of the performed field survey are that: a) farmers applies pesticides on crop fields improperly, with use of traditional methods and inadequate equipment, c) producers applies pesticides without previously prepared plant protection program and insufficient knowledge about the biology of the pests and weds, they are dealing with, d) overdose with low effects on pests especially in vegetable and orchard production is a common situation, e) know-how and skills regarding safety and efficient application of pesticides are not on adequate level.

The use of pesticide is estimated on a total area of 7,408 ha. (Tab. 4) out of the 9,960 ha of arable land, with a total input of 45,339 l of pesticides, or in average 6.12 l/ha. The net area of vineyards and orchards on WB level plus the estimated area of certain categories of field crops were used as a base for calculation of areas treated with pesticides. Areas under field crops were reduced since only part of this category is protected in practice and due to the fact that in many cases areas under field crops are abandoned for several years or more. Data collected during our field survey, historical field survey data, as well as data from the local authorities (JP Ohridski komunalec) about the quantities of used pesticides in the region, were used for estimation of the quantities of pesticides used per hectare.

According the data from JP “Ohridski komunalec” (Dimitrovska Radevska. B. 2014) the average quantities of applied pesticides significantly differ depending to the type of pesticide or the crop type. For instance. in average pesticides in vineyards are applied 2-3 times in a quantities of 3-3.5 liters

while in cereals they are used 1-2 times per year in a quantities of 2-3 liters. which is in line with our estimation of 6.12 l/ha in average for all land use types.

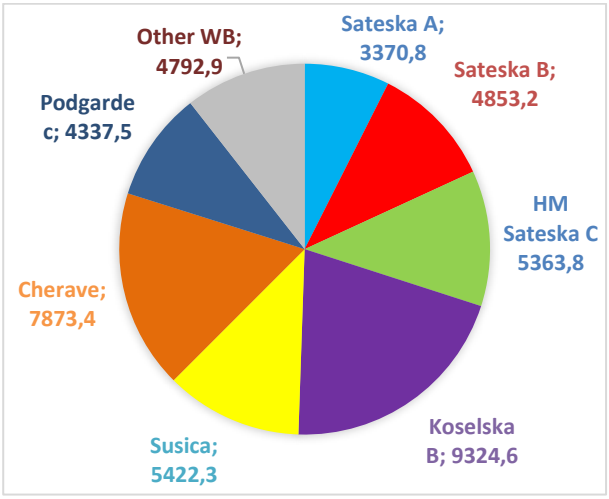
Graph 3. Area of treated agricultural land with pesticides, ha



Out of the total treated area of 7,408 ha over 4,800 ha (64.9 %) are in WBs on North Macedonia side, of which 3,124 (65%) are within three WB (Sateska-1, HM Sateska-3 and Koselska-2). On the Albanian side the total treated area is 35% out of total 7,408 ha, while more than 70% of the treated area is in Cherave and Pograec WB.

If we analyze the inputs of pesticides per water body out of the data presented in Table 4 and Graph 1, it can be seen that more of 60% of the applied pesticides in the catchment are applied within four water bodies: Koselska_2 with total quantities of 9,325 l (20.6 %). HM_Sateska_3 with 5,364 l or 11.8% and Susica with 5,422 l (11.95 %) on North Macedonia side and Cherave with a approx. 17 % or 7,873 l of the total quantities.

Graph 4. Quantity of applied pesticides



Taking in consideration the location of the abovementioned water bodies we can conclude that the first two: Koselska_2 and HM_Sateska_3 can generate a serious direct diffuse pollution to the Ohrid Lake and the groundwater as well through leaching of nitrogen and residues of pesticides. while the other two water bodies have a direct influence on Ohrid Lake tributaries: Sateska and Cherave river. Still due to the high inputs of pesticides in these two water bodies despite its indirect influence on Ohrid Lake. they can be considered as a zones with high risk of diffuse pollution of Ohrid Lake. On the

other hand. the pesticide loads in some water bodies are with negligible quantities. like: Koselska_1 and Radozhda with 29.7 and 87.6 l. respectively.

Main conclusions out of the performed field survey which can be of importance for estimation of the fertilizers and pesticides load quantification are:

- the quantiles applied fertilizers and pesticides and the dynamic of its application significantly vary in different regions.
- in most of the cases fertilizers and pesticides are applied with no previous consultations with plant nutrition experts or soil laboratory testing and preparation of fertilization plan.
- the frequent application and a large amounts of pesticides. especially in orchards and vineyards leads to its emerging into other natural resources like air and water resources.
- techniques and methods of fertilizers application are extensive, hence even in a cases when drip irrigation is in place, fertigation practices are not applied, which influences the efficiency of nutrients uptake,
- in some water bodies especially these with low intensity agricultural production like: Koselska_1, Radozhda, Kalishta, Velidab and some parts of Sateska_1, abandoned agricultural land is very common situation. Is such cases no human activities including fertilization and plant protection is not applied for some period of time, which additionally complicates the quantification of nutrients and pesticides in the Ohrid lake catchment.
- Promotion of methods for replacement of mineral fertilizers with organic amendments such green manuring, mulching of organic residues and by-products can significantly contribute to better management of agricultural land and improvement of soil productivity potential,
- More sound implementing of Nitrate directive provisions in place are of crucial importance in protection of water resources from diffuse pollution aroused from agricultural production
- Natural control agents. such as beneficial bacteria, viruses, insects and nematodes can be used in improving crop protection successfully

Livestock and manure management

According the SSO data (2017, Structure of agricultural holdings), only 41.5% of the total number of farms in the Southwest region where the catchment area from North Macedonia is situated are breeding animals, while specialized in breeding livestock are 34% out of the farms breeding animals. It should be noted, that these figures are related to the region as a whole, but still it can give some orientations about the general trend in the catchment area. The total number of animals in the catchment is over 52000 heads and over almost 94000 units of poultry, according to data from the MAFWE`s Regional Office in Ohrid and the Regional Office of MARD in Korca.

The total number of cattle is 4,313, almost evenly distributed on the both sides of the lake catchment. In most cases agricultural holdings are breeding dairy cattle in a small heard of less than 5 or in many cases 2-3 heads. The total number of dairy cattle is 48,2% out of the total number of cattle, mainly distribute within several WB which according the previously analyzed land use, can provide a solid base for livestock, like: Sateska-1, Koselska-2, Pogradec and Cherave.

Sheep are kept mainly for lamb meat production and milk production (rarely for wool). Milking sheep are raised by individual agriculture holdings. Sheep-breeding is semi-nomadic and it is performed by grazing during summer. The total number of sheep in the catchment area is estimated to 24,462 heads, out of which 71.2% are lambs. Ships are kept in small herds of less than 500 heads, mainly located at remote location in rural areas. More than 60.1% of the total number of sheep are located within four WB: Sateska-1, Struga_Drim, Pogradec and Cherave. In the recent years, there is increasing interest in goat breeding due to demand for goat dairy products are increasing and there is a potential for development of the sector. In the catchment area, the estimated number of goats is 9,768

distributed similarly like sheep within several WB: Sateska-1, Koselska_N. Pogradec and Cherave. Almost 71% of the total numbers of goats are situated within these four water bodies. Having in mind the fact that the majority of sheep and goats breeding is within this four WB, despite it scattered distribution, still if any pressure might be expected, it will appear on the territory of these WB. Of particular interests are WB Pogradec and Kosleksa_B, due to their direct exposure to the lake.

Table. 5 Livestock production

WB	Cattle	Sheep	Goats	Pigs	Poultry
Sateska-1	523	4822	2148	348	9971
Sateska _B	121	217	343	42	5983
HM Sateska-3	179	168	44	10	3989
Struga-Drim	160	2200	318	/	2604
Kalishta	81	613	124	/	1452
Radozhda	36	272	224	/	3369
Koselska-1	/	1814	10	/	2243
Koselska-2	617	1698	1698	48	17945
Sushica	314	1345	491	3	14804
Velidab	358	979	371	/	8972
Stud Kanal	14	/	87	/	897
Pogradec	442	2656	1012	134	4347
Cerave	980	5021	1987	175	10433
Udenisht	256	1461	506	/	3043
Lin	232	1195	405	/	3912
Total	**4313**	**24461**	**9768**	**760**	**93964**

Pig are represented in a very small number of just 760 units, out of which almost 50% are situated in Sateska-1 WB. There are no pig farms or any other form of intensive pig breeding in the catchment area, which coupled with the small number of pigs scattered over agricultural holdings in the catchment area, leads to a conclusion that the influence of pig breeding to the overall ecosystems, can be considered as negligible.

Manure management

In addition to chemical (mineral) fertilizers, farmers apply nutrients on their fields in the form of animal manure. However, when nutrients (especially nitrogen and phosphorus) are not fully utilized by the growing plants, they can be lost from the farm fields and negatively impact air and downstream water quality.

The quantities of manure produced per year within the catchment area, and the total contents of nutrients (N. P and K) are presented in the Table 6. As expected, the quantities of manure produced within each WB is in line with the number of animals in the WB (Graph 5).

In some cases, there are slight discrepancies between the number of animals and produced manure, which is result to the different number of animal varieties.

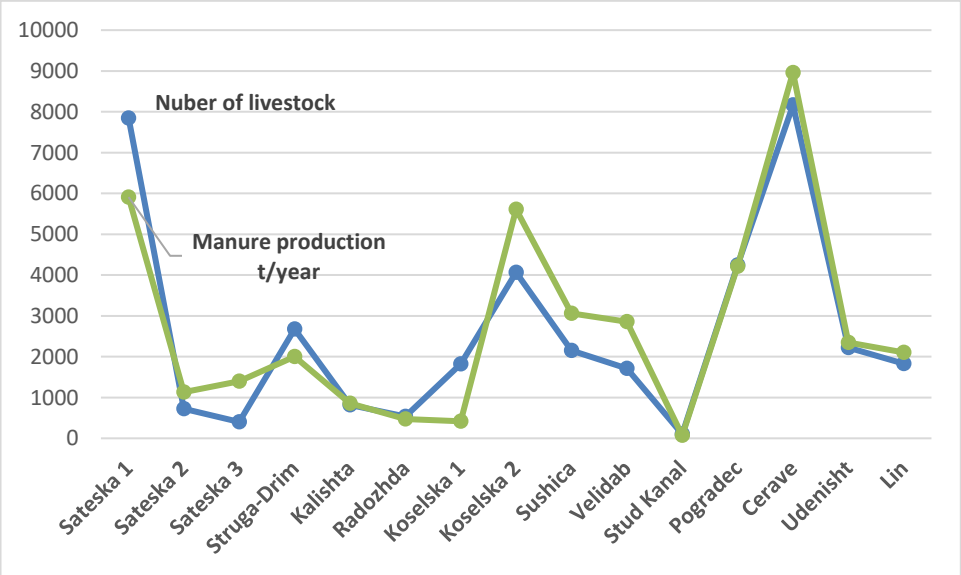
The highest content of manure production is in WB Sateska_1 (5,909.3t/year), Koselska_2 (5,612.8t/year) on North Macedonia side and Cherave (8,962 t/year) on Albanian site, which is result to the high number of cattle and sheep in these WB.

Table 6. Quantities of yearly manure production and nutrient loads

WB	Manure	N	NH_4-N	P	K
	t/year	kg			
Sateska 1	5909,3	37961,3	13669,1	22615,3	27940,8
Sateska 2	1129,2	7617,5	2332,0	4343,7	5063,0
Sateska 3	1395,2	8707,9	2622,4	4851,0	5671,1
Struga-Drim	2000,3	12485,4	4603,3	7508,0	8685,3
Kalishta	859,6	5409,9	1841,1	3152,5	3706,8
Radozhda	471,4	3397,7	1086,2	1991,0	2317,8
Koselska 1	418,8	2564,2	1421,4	1889,2	1644,6
Koselska 2	5612,8	34939,8	11533,7	20202,3	22376,0
Sushica	3062,6	20206,8	6338,0	11598,4	13034,9
Velidab	2858,4	18029,6	5670,3	10200,9	12148,6
Stud Kanal	69,7	530,4	162,8	301,9	442,0
Pogradec	4215,0	26478,5	9055,5	15461,6	19088,8
Cerave	8962,1	56314,9	18811,1	32596,2	40267,7
Udenisht	2349,2	14804,6	4946,6	8598,4	10538,1
Lin	2103,5	13328,6	4396,9	7729,8	9324,7
Total	**41417,1**	**262776,8**	**88490,5**	**153040,3**	**182250,2**

Manure as organic fertilizer is commonly applied in a doses of 40-50 t/ha, on orchards or intensive vegetable production, every 4-5 years. This is a high quantity of organic material that needs a special attention during the process of transportation and application. For these reasons, manure is usually applied in the vicinity of the livestock farms, mining that almost the whole quantity of produced manure is applied on agricultural land within the same WB.

Graph 5. Quantities of livestock and yearly manure production per water body



The total nitrogen load in manure is estimated on 262.8 t/year, while the phosphorus and potassium loads are estimated on 153 t/year and 182.3 t/year respectively.

Manure application on arable land is a fundamental measure in maintenance soil organic matter content. The quantities of manure production are limited and insufficient to meet the actual requirement of arable land in the catchment area. Another obstacle which affects the efficiency of the already limited quantities of manure is the inappropriate way of management.

In practice, agricultural holdings possess small number of cattle or sheep, due to what the quantities of manure (daily production) is very small. Farms often do not have adequate facilities for storing and fermentation of manure, which leads to significant loss of nutrients (Picture 5 and 6). In addition, in many cases manure is stored near water courses or wells which, although in small quantities, manure can have a serious impact on drinking water and human health.

During the field visits, it was reviled that farmers in the catchment area, do not practice proper storage of manure (inappropriate conditions) and its application. In many cases manure is stored on open space uncovered for few months, or left as a small clumps in the field before being scattered and incorporated in the soil with ploughing. Until than the majority of nutrients are lost, and the efficiency of such managed manure is almost zero.

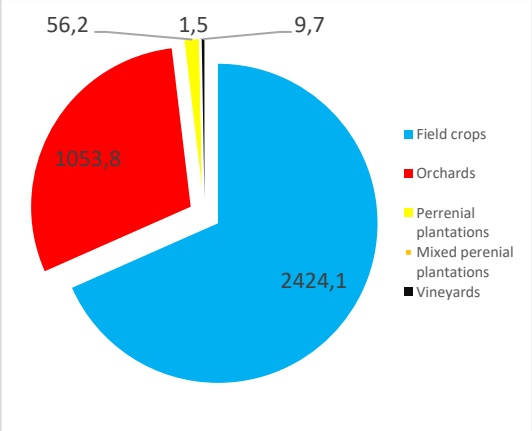
There are many ways that farmers can reduce nutrient losses from their with manure in order to protect water resources from pollution, including, but not limited to: adopting nutrient management techniques (applying nutrients in the right amount, at the right time of year according Nitrate directive, with the right method and with the right placement), ensuring year-round ground cover (plant cover crops), planting field buffers (plant trees, shrubs and grasses along the edges of fields; this is especially important for a field that borders water bodies), implementing conservation tillage (reduce erosion, runoff and soil compaction), managing livestock access to streams (install fence along streams, rivers and lakes to block access from animals), etc.

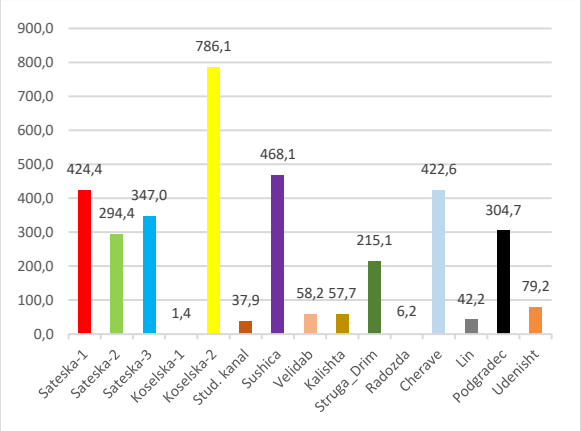
Abstraction/hydrological alteration of surface water for irrigation

The Lake Ohrid basin is situated in a region with average sum of precipitations per year of 662.3 mm/year (period 1970-2000) is considered as more humid in comparison to the country average. Still, irrigation, especially in the modern and intensive systems of agricultural production is an essential agro-technical measure for achieving of high and stabile yield with adequate quality. There are very limited agricultural production systems. where stable production is achievable in a rain-fed conditions. Such systems are production of cereal crops or forage crops production on a higher altitudes with low evapotranspiration during the vegetation season.

As mentioned before, out of the total agricultural land, almost 82.50% are field crops, out of which only cereals (what, barley and rye) with 49.5% (4929.41 ha), vineyards (466.58 ha) and certain types of forage crops can be cultivated under rain-feed conditions. All the others within this category needs to be irrigated.

Estimation of the irrigated area in the catchment area is based on the area occupied with certain categories of land use and field visits and delineated (Map 1, Annex 3) with support of the available graphical data sets with GIS technology. The territory of irrigated arable land from both sides of the border is estimated on 3,545.5 ha (Graph 6), out of which almost 76.1% are on North Macedonia side of the border, mostly situated within four WB Sateska-1 and C, Koselska-2 and Sushica. On the Albanian side, the total irrigated area is around 850 ha, out of which more than 85% is situated within Cherave and Pogradec WB (Figure 7).

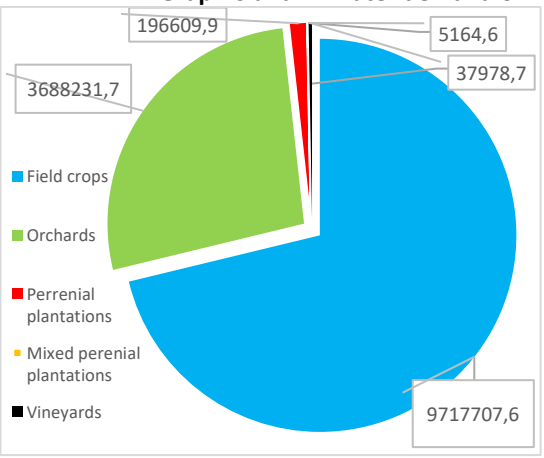


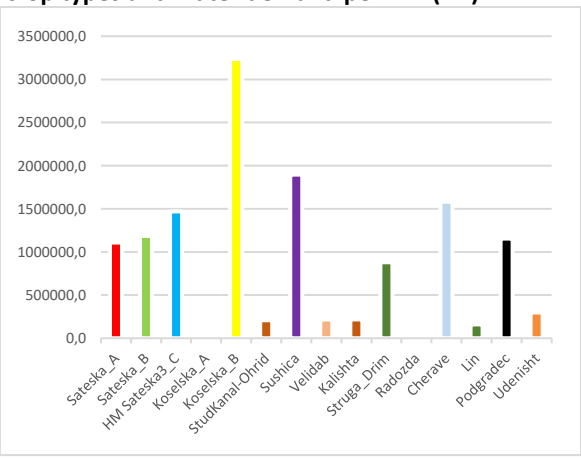


Water demand

Crop water demand is in line with the agricultural systems on place and area under certain crop types. More than 71.2% of water demand in the catchment walls within field crops, generally for irrigation of maize and industrial crops (tobacco and potatoes). The other part of 27.3% is used for irrigation of orchards. The other categories like, mixed perennial plantation and vineyards absorbs the other part of the irrigation water. Having in mind the age, location, planting system applied, climatic conditions in the catchment area, and on the base of field surveys perform, in general vineyards in the catchment area are not irrigated, except in some very isolated cases.

Graph 6 and 7. Water demand of major crop types and water demand per WB (m^3)





Crop water demand in m^3/WB vary in a very wide ranges, of only 5,679.4 m^3 in Koselska-1 up to 3.24 mil. m^3 in Koselska-2. Again, water demand is closely related to the area under certain crop type, intensity of the agricultural systems and the cropping pattern applied. The majority of orchards (406.9 ha), vegetables (326.3 ha) and maize (347.8 ha) are situated in the two WB on North Macedonia side (Kosleska_B and Sushica), resulting in total water demand of 36.7% out of total estimated, 13.65 m^3. On Albanian side the crop water demand as expected have the highest values in Cherave and Pogradec WB of 1.58 and 1.15 mill m^3.

If we take into consideration the actual state of the irrigation systems and irrigation techniques applied with more than 52.7% and 82.7% of furrow irrigation in North Macedonia and Albania parts respectively (Table 6), the estimation of the total needs to satisfy the projected crop water demand raises up to 42.03 m^3. In case of modernization of the irrigation systems and techniques applied over whole irrigated area, our estimation is that the water use efficiency from 30% (furrow irrigation) will

ruse up to 70%, which can save more than 18.01 mil. m^3 of irrigation water, which will decrease the needs of water or irrigation to 24.01 mill m^3.

Abstraction of surface water for irrigation

Abstraction of surface water is not a common practice in the catchment area and is used in some areas near to a big water courses, like Koselska, Sateska or Cherave river, or areas very near to the lake. like Tushemisht. Studenchista. Udenisht etc. Surface abstraction is mainly used for furrow irrigation and mostly applied on a spring crops which are traditionally cultivated in a rows which enables application of this technique. like: maize. bean. tobacco. some vegetables (cabbage. potato etc.). In a case of presence of irrigation scheme in the area, which usually is not a case, the abstraction of surface water would be more common practice due to a better accessibility of the fields to a stable and abundant water quantities.

There are 4 small water reservoirs in the basin, one in the vicinity of Slatino village (Sateska-1 WB) and another 3 reservoirs situated in Cherave WB which are used for irrigation.

According to the existing data and field visits there is no functional irrigation schemes in place on the North Macedonia side. Several years ago the agricultural area of Izdeglavsko field was irrigated from a small reservoirs nearby Slatino village, until the main channel was stacked due to land slide which damaged the dam several years ago. Agricultural land in the vicinity of Slatino village is irrigated with direct abstraction of surface water from Slatinska, while the area nearby Izdeglavje is irrigated from Sateska River. Water from Sateska River at its channel is used or irrigation of vegetable production and orchards in WB Sateska-2 and C.

Table 6. Irrigated area and share of different irrigation techniques

Catchment Ohrid Lake	**Arable land. ha**	**Irrigated area. ha**
	9960.97	3545.30
North Macedonia	6689.32	2696.65
% of total and irrigated land	67.16%	76.06%
Albania	3271.65	848.70
% of total and irrigated land	32.85%	23.94%
Type of irrigation	**irrigated area. ha**	**% of irrigated area**
Irrigated area in North Macedonia (ha)	**2696.65**	
Furrow irrigation	1420.70	52.68%
Sprinkler irrigation	610.57	22.64%
Drip irrigation	665.36	24.67%
Irrigated area in Albania (ha)	**848.70**	
Furrow irrigation	701.67	82.68%
Sprinkler irrigation	116.53	16.61%
Drip irrigation	30.50	26.17%

A small system of channels in the vicinity of Daljan, which are almost ruined and occasionally maintained by the local producers (Picture 7), is used for furrow irrigation of agricultural land under maize and orchards. Water used in this locality is abstracted from Koselska, Sushica and Ozdolenska rivers.

Surface water is used in the most part o Pogradec WB. There are several main channels which pass through the agricultural land of Pogradec WB (Picture 9 and 10). In Cherave WB major part of the estimated 422,6 ha (Graph 7) are irrigated with surface water abstracted from 3 dams situated into the area of this water body.

Abstraction of ground water for irrigation

In the past decades abstraction of ground water with drilling of metal pipe wells or irrigation has become a common and convenient practice for the farmers. As a result, significant part of agricultural area, especially orchards, are irrigated through abstraction of ground water. This practice has a serious impact of groundwater resources, having in mind its limited availability. In a case of uncontrolled drilling of wails with no official record of its number and capacity it is very difficult to have a precise overview of the quantities of abstraction of ground water and to predict the influence of this practices on groundwater. According available data from a recent measurement in other regions the level of ground water mainly due to this factor is significantly decreased.

According the available data and on the base of the crop structure and field visits, it can be estimated that the biggest part of the ground water used for irrigation is applied through drip irrigation especially in orchards and vegetable production, while the other part is applied through furrow irrigation on maize and industrial crops.

In an absence of official data or the number of wells and its capacity, it is extremely difficult to estimate which part of the irrigated area is irrigated with ground water and what part of the irrigated water is abstracted om ground water. If we assume that ground water is used or irrigation of all orchards and vegetables with drip or sprinkle irrigation and a very limited area with furrow irrigation, then the total area irrigated with ground water abstraction, can be estimated to be 1,937 ha (Table 6), with 23.6 mill m^3, out of the total estimated needs of 42 mill m^3 irrigated water.

Forestry

According CORINE Land Cover (2012), the category Forest and Forest land and rangeland covers 47,912 ha or 45.8% of the catchment area. Of the total area covered with forest and forest land the category of forest land occupies more than 45,802 ha. Within this category are broad life forest with more than 92.44% of the total forest land (42,362 ha) and the rest of 7.5% is coniferous forest (976,8 ha) and mixed forest (2,478 ha). It should be noted that the Albanian part is less afforested with 28.8% of the whole territory (Albanian side), while the North Macedonia part is much more afforested with more than 47.5% of the total catchment area. Based on remotely sensed data in some water bodies of the Albanian part like Cherave and Pogradec afforestation activities can be detected which is of big importance for protection of Cherave river water course from soil erosion and deposition of soil sediment in the river and ultimately in Ohrid lake.

Forest land and rangeland occupies in total 17,365ha in the catchment area, of which 5,830 ha (27.7%) on the Albanian part of the catchment, while the area of forest land and rangeland in North Macedonia is 12,872.8 or 15.4% which is almost double less percentage of coverage. This land cover category encompasses the following four CORINE classes: Sclerophyllous vegetation, Sparsely vegetated areas, Transitional woodland-shrub, characterized with sparse and degraded vegetation coverage on a sloppy terrains. is much prone to soil erosion.

In general forests and forest land are state owned in North Macedonia, managed by the PE. Makedonski sumi through its regional branches (in total 33 for the country) in Ohrid for Galichica Mountain and Struga for Jablanica Mountain.

The total wood mass of the catchment area is estimated on 5,186,638 m^3 or 93.5 m^3/ha. with annual biological growth of 114,243 m^3. or 2.06 m^3/ha. According the data from the State Statistical Office for 2017 the total area of forests in the South east region of North Macedonia is in total 185,151 ha. According the same source the annual wood cut volume is 159,431 m^3, or on the average 0.86 m^3/ha. If we downscale this figures for the catchment area of forest land, we can conclude that the catted wood mass in the catchment area is in the ranges of 40-45,000 m^3. If we compare the catted wood mass with the annual biological growth we can note a positive trends with the forests growth, but still what is more important is its management. In almost all cases wood mass is exploited with clear cut approach, which if not followed with immediate anti-erosive measures can have a devastating influence on soil especially on inclined terrains. Such case during the field visits were noted in the Koselska_1 and Sateska_1 and 2 water bodies.

In terms of the spatial distribution of the forest area in the catchment, it can be concluded that the majority of the forest land falls within two WB: Sateska-1 with more than 43% and Koselska-1 with 16.87%. This means that this 2 WB encompasses approx. 60% of the total area under forests, while the remaining 40% is more or less evenly distributed among the other WB in ranges od 2-5% of the forest land. Forest land are in Struga_Drim WB is bellow 1%, as a result of its plat relief mainly occupied with agricultural land and Lin because of the presence of highly degraded hilly terrains occupied with natural grassland and transitional woodland shrubs.

Main sources of pressures on forests, forest land and rangelands in the basin are related to: a) intensive degradation of forests as a result forest fires and illegal cut. b) inexistence of continuous and organized afforestation of degraded forest areas. c) unsustainable management practices with excessive cut of forests for fuel wood.

APPENDIX 1

Picture 1

Picture 2

Picture 3

Picture 4

Picture 5

Picture 6

Picture 7

Picture 8

Picture 9

Picture 10

APPENDIX 2

Water bodies	Culture	Total area	MINERAL FERTILIZER								PESTICIDE	
			treated total area	quantity of fertilizers	total quantity of applicated			total quantity of accumulated			treated area	total quantity of applicated
					active matter							
					N	P	K	N	P	K		
		ha	ha	t/total area ha							ha	(l/total area)
Sateska 1-Debarca	filed crops	2054,49	2054,49	650,20	124,51	67,92	75,59	28,64	16,21	-39,83	1316,50	2977,38
	permanent loan	4844,05										
	orchards	14,61	14,61	5,84	1,04	0,58	0,88	0,34	0,35	-0,28	14,61	292,17
	perennial plantations	9,37	9,37	1,87	0,15	0,30	0,45	-0,19	0,19	-0,11	9,37	93,74
	mixed perennial plant.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	vineyards	0,38	0,38	0,15	0,03	0,02	0,02	-0,01	0,00	-0,03	0,38	7,50
	TOTAL	6922,90	2078,85	658,06	125,72	68,81	76,94	28,78	16,75	-40,26	1340,86	3370,79
Sateska 2-Debarca	filed crops	429,34	429,34	149,61	27,86	16,79	18,60	7,74	6,73	-3,82	301,46	717,01
	permanent loan	293,41										
	orchards	91,43	91,43	36,57	6,49	3,66	5,49	2,13	2,20	-1,78	91,43	1828,56
	perennial plantations	17,67	17,67	3,53	0,28	0,57	0,85	-0,35	0,35	-0,21	17,67	176,65
	mixed perennial plant.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	vineyards	106,55	106,55	42,62	7,56	4,26	6,39	-2,02	1,39	-7,99	106,55	2130,94
	TOTAL	938,39	644,98	232,33	42,20	25,27	31,32	7,49	10,67	-13,81	517,10	4853,16
Sateska 3	filed crops	810,84	810,84	295,16	55,92	31,88	35,01	15,27	11,95	-6,18	592,78	1396,50
	permanent loan	247,20										
	orchards	153,48	153,48	84,42	14,73	8,60	12,89	7,41	6,15	0,69	153,48	3069,66
	perennial plantations	18,53	18,53	3,71	0,30	0,59	0,89	-0,45	0,34	-0,36	18,53	185,29

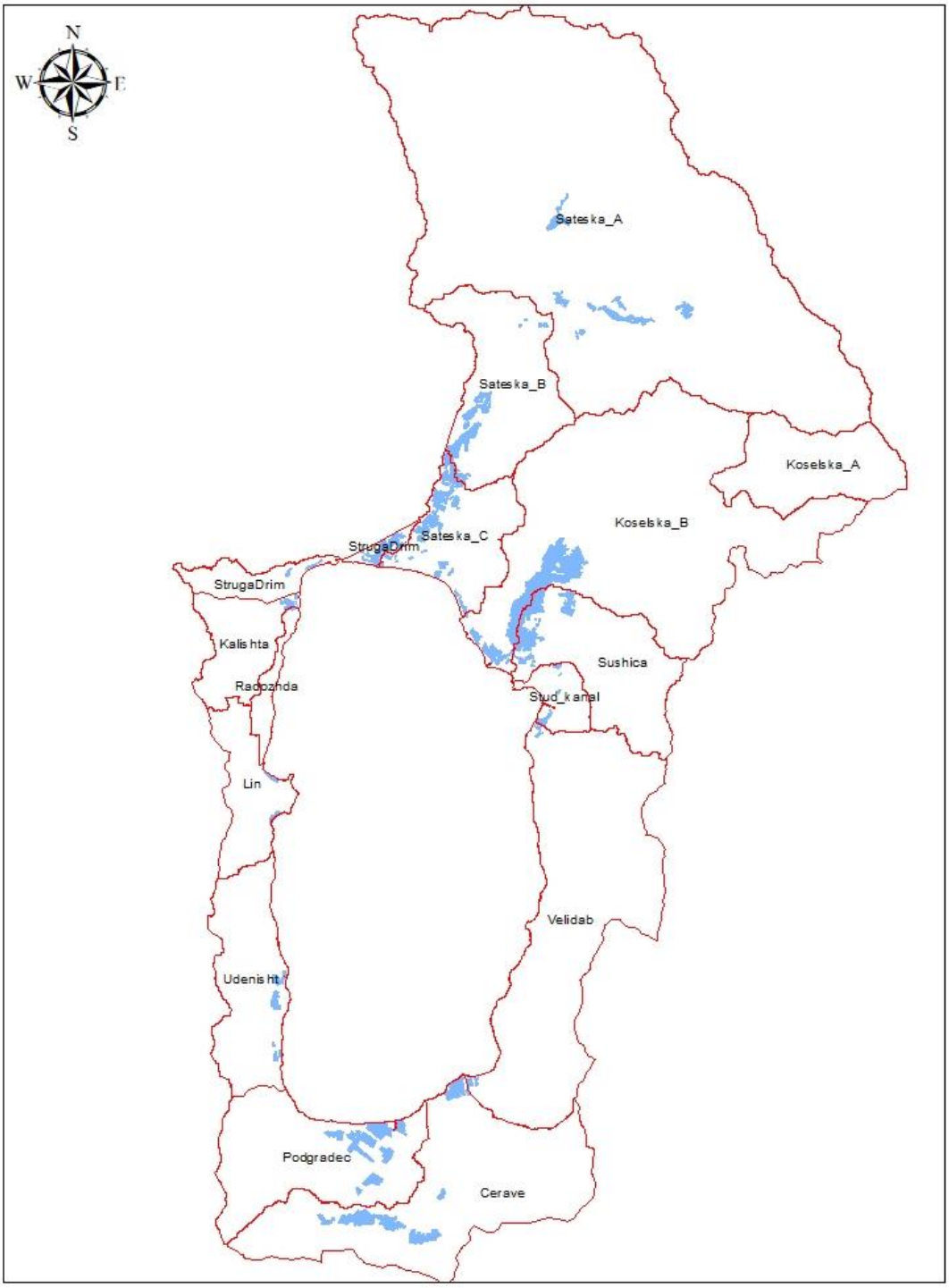
	mixed perennial plant.	1,06	1,06	0,21	0,02	0,03	0,05	-0,02	0,02	-0,02	1,06	10,56
	vineyards	35,09	35,09	15,79	2,63	1,68	2,53	-0,53	0,74	-2,21	35,09	701,78
	TOTAL	1266,19	1019,00	399,29	73,60	42,79	51,37	21,68	19,20	-8,08	800,93	5363,79
Koselska 1-Ohrid	filed crops	12,64	12,64	12,64	4,41	0,90	0,47	0,07	0,12	-0,18	8,93	17,86
	permanent loan	779,73										
	orchards	0,59	0,59	0,59	0,24	0,04	0,04	0,00	0,01	-0,03	0,59	11,88
	perennial plantations	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	mixed perennial plant.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	vineyards	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	TOTAL	792,96	13,23	13,23	4,65	0,94	0,51	0,07	0,13	-0,21	9,52	29,74
Koselska 2-Ohrid	filed crops	944,94	944,94	366,92	72,57	37,55	40,30	28,70	12,02	-13,00	567,74	1321,08
	permanent loan	1533,12										
	orchards	315,34	315,34	204,97	36,11	20,18	30,27	-1,73	7,57	-32,80	315,34	6306,84
	perennial plantations	28,14	28,14	14,07	2,36	1,69	2,53	1,22	1,31	0,63	28,14	281,40
	mixed perennial plant.	0,87	0,87	0,43	0,07	0,05	0,08	0,04	0,04	0,03	0,87	8,70
	vineyards	70,33	70,33	45,71	8,62	5,63	8,44	-0,88	2,78	-5,80	70,33	1406,62
	TOTAL	2892,74	1359,62	632,10	119,73	65,10	81,63	27,35	23,72	-50,93	982,42	9324,65
Stud.kanal-Ohrid	filed crops	38,33	38,33	14,03	2,50	1,46	1,61	0,28	0,44	-0,61	26,50	59,08
	permanent loan	67,25										
	orchards	4,13	4,13	2,27	0,44	0,20	0,30	0,17	0,11	-0,15	4,13	82,56
	perennial plantations	3,67	3,67	0,73	0,06	0,12	0,18	-0,07	0,07	-0,04	3,67	36,69
	mixed perennial plant.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	vineyards	9,27	9,27	6,02	1,14	0,74	1,11	-0,12	0,37	-0,76	9,27	185,32
	TOTAL	122,64	55,39	23,06	4,14	2,52	3,20	0,27	0,99	-1,56	43,56	363,66
Sus ica- Oh	filed crops	541,21	541,21	148,90	23,88	19,97	22,10	0,93	6,04	-8,72	331,67	808,79

	permanent loan	1578,51										
	orchards	184,53	184,53	110,71	20,39	10,33	15,50	8,49	6,37	-4,34	184,53	3690,56
	perennial plantations	41,49	41,49	8,30	0,66	1,33	1,99	-0,83	0,83	-0,50	41,49	414,88
	mixed perennial plant.	2,23	2,23	0,45	0,04	0,07	0,11	-0,03	0,05	0,00	2,23	22,31
	vineyards	24,29	24,29	15,78	2,98	1,94	2,91	-0,30	0,96	-2,00	24,29	485,79
	TOTAL	2372,25	793,75	284,13	47,94	33,65	42,61	8,26	14,24	-15,57	584,21	5422,33
Velidab-Ohrid	filed crops	137,94	137,94	46,99	8,97	5,29	5,75	0,75	1,50	-3,26	96,47	206,94
	permanent loan	4872,64										
	orchards	4,59	4,59	2,75	0,39	0,34	0,48	0,09	0,25	-0,01	4,59	91,73
	perennial plantations	39,84	39,84	17,92	3,43	1,59	2,39	1,99	1,12	0,00	39,84	398,43
	mixed perennial plant.	1,18	1,18	0,53	0,10	0,05	0,07	-0,02	0,03	0,00	1,18	11,84
	vineyards	20,42	20,42	12,25	1,73	1,53	2,14	-1,03	0,70	-1,99	20,42	408,47
	TOTAL	5076,62	203,98	80,44	14,61	8,80	10,83	1,79	3,59	-5,27	162,51	1117,42
Kalista-Struga	filed crops	118,38	118,38	41,44	8,05	4,42	4,55	1,35	1,14	-1,71	78,35	169,79
	permanent loan	80,14										
	orchards	0,12	0,12	0,05	0,01	0,00	0,01	0,00	0,00	0,00	0,12	2,31
	perennial plantations	0,41	0,41	0,08	0,01	0,01	0,02	-0,01	0,01	0,00	0,41	4,14
	mixed perennial plant.	0,34	0,34	0,07	0,01	0,01	0,02	0,00	0,01	0,00	0,34	3,42
	vineyards	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	TOTAL	199,39	119,25	41,63	8,07	4,45	4,60	1,34	1,16	-1,72	79,22	179,66
Struga Drim-Struga	filed crops	346,40	346,40	135,64	27,61	12,97	13,25	5,23	2,86	-6,14	240,42	497,58
	permanent loan	118,77										
	orchards	23,83	23,83	15,48	2,92	1,91	2,86	1,56	1,45	0,60	23,83	476,54
	perennial plantations	5,62	5,62	1,96	0,39	0,22	0,34	0,19	0,16	0,00	5,62	56,17
	mixed perennial plant.	0,39	0,39	0,08	0,01	0,01	0,02	-0,01	0,01	0,00	0,39	3,86
	vineyards	0,47	0,47	0,26	0,05	0,03	0,04	-0,03	0,01	-0,07	0,47	9,44

	TOTAL	495,48	376,71	153,42	30,97	15,14	16,51	6,94	4,49	-5,61	270,72	1043,59
Radozda-Struga	filed crops	21,48	21,48	7,67	1,46	0,83	0,90	0,18	0,20	-0,42	14,77	33,99
	permanent loan	23,81										
	orchards	0,67	0,67	0,27	0,05	0,03	0,04	0,01	0,02	-0,02	0,67	13,40
	perennial plantations	0,78	0,78	0,16	0,01	0,02	0,04	-0,02	0,02	-0,01	0,78	7,76
	mixed perennial plant.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	vineyards	1,62	1,62	0,65	0,12	0,06	0,10	-0,13	-0,01	-0,27	1,62	32,46
	TOTAL	48,36	24,55	8,74	1,64	0,94	1,07	0,05	0,22	-0,72	17,83	87,61
Cerave-Albanija	filed crops	1370,58	1370,58	583,21	122,76	53,23	57,31	5,99	-0,98	-57,97	1037,68	2320,80
	permanent loan	494,18										
	orchards	161,99	161,99	97,19	19,03	12,15	17,01	11,74	9,72	4,86	161,99	3239,80
	perennial plantations	16,58	16,58	3,32	0,27	0,53	0,80	-0,33	0,33	-0,20	16,58	165,82
	mixed perennial plant.	0,75	0,75	0,15	0,01	0,02	0,04	-0,02	0,01	-0,01	0,75	7,48
	vineyards	106,98	106,98	64,18	12,57	8,02	11,23	6,92	6,33	2,76	106,98	2139,53
	TOTAL	2151,06	1656,88	748,04	154,64	73,96	86,38	24,30	15,42	-50,56	1323,97	7873,42
Lin-Albanija	filed crops	204,87	204,87	84,58	17,73	7,95	8,50	-0,46	-0,15	-8,37	155,96	345,31
	permanent loan	34,55										
	orchards	13,12	13,12	7,87	1,54	0,98	1,38	0,95	0,79	0,39	13,12	262,46
	perennial plantations	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	mixed perennial plant.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	vineyards	12,15	12,15	7,29	1,43	0,91	1,28	0,79	0,72	0,31	12,15	243,00
	TOTAL	264,70	230,15	99,74	20,70	9,84	11,15	1,28	1,35	-7,66	181,24	850,77
Po gra dec	filed crops	952,49	952,49	384,55	79,79	37,09	40,01	-1,59	-0,20	-39,86	725,85	1625,58

	permanent loan	516,31										
	orchards	67,44	67,44	37,09	6,47	3,78	5,66	3,44	2,76	0,61	67,44	1348,72
	perennial plantations	11,45	11,45	4,00	0,80	0,46	0,69	0,38	0,32	0,00	11,45	114,50
	mixed perennial plant.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	vineyards	62,44	62,44	34,34	5,99	3,50	5,24	2,70	2,51	0,30	62,44	1248,73
	TOTAL	1610,13	1093,81	459,98	93,06	44,82	51,61	4,93	5,40	-38,95	867,18	4337,53
Udenisht-Albanija	filed crops	256,29	256,29	104,04	21,44	9,93	10,69	-0,29	-0,36	-11,01	192,27	430,11
	permanent loan	53,10										
	orchards	17,92	17,92	10,75	2,11	1,34	1,88	1,30	1,08	0,54	17,92	358,41
	perennial plantations	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	mixed perennial plant.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	vineyards	16,59	16,59	9,95	1,95	1,24	1,74	0,43	0,40	-0,32	16,59	331,84
	TOTAL	343,91	290,81	124,74	25,49	12,52	14,31	1,44	1,11	-10,79	226,78	1120,36

ANNEX 3 Irrigated area in Lake Ohrid Watershed



LOWMP Supplement IV
Ancient Lake Ohrid as biological hot spot

Ancient Lake Ohrid as biological hot spot

The term "ancient lake" is applied to any lake that existed across the last glacial cycle, >130 ka yr (Hampton et al. 2018). Another term that can be used is "long-lived" lakes. Most lakes around the globe are younger than 10,000 years (post-glacial origin) and only a few have survived more than 100 ka (Martens 1997). Ancient lakes are considered qualitatively different from other younger (short-living or post-glacial) lakes, because they hold relatively high proportions of endemic species (Boxshall & Jaume 2000). High diversity and endemism can be noticed across almost all eukaryotic groups in most (if not in all) ancient lakes (Cristescu et al. 2010). However, the level of endemism and diversity vary among the lakes. The success of endemism with elevated species diversity can be attributed to the long-term persistence and ecological stability of ancient lakes. However, all global environments are subjected to stress events including catastrophic event(s) during their geological history.

Macroecological principles can be applied to ecological functions in the African Great Lakes; these functions include: (*i*) Taxonomic diversity tends to increase with area of the lake, (*ii*) more ecological niches allow greater taxonomic diversity, and (*iii*) the degree of ecosystem stability determines the periods during which adaptation can occur. However, these principles are interconnected and depend on global location and the structural morphology of the lake. Larger lakes have greater niche diversity, are more stable and have larger resistance and resilience to disturbances (Jovanovska et al. 2016).

Two types of ancient lakes can be distinguished: (*i*) lakes that didn't experienced major catastrophic or near-catastrophic events during its history, (*ii*) lakes that experienced major catastrophic or near-catastrophic events in relatively recent geologic time. Both types contain lakes with a high level of biodiversity and endemism, however, biologically these lakes evolved and function differently. Species radiations are in both lake types: reservoir functions (taxa points of dispersal) seem to predominate among the lakes without catastrophic events, while cradle functions (taxa refugia) are predominate among lakes that have experienced near catastrophic events. Extinctions caused by some catastrophic events create new ecological opportunities for alternative species introductions changing the evolutionary path of the lake and possibly regional diversity. The ultimate question, how important are these lakes in stabilizing regional and global diversity: are the lakes species sinks (refugia) or sources (dispersal centers)?

A consistent and interesting phenomena in ancient lakes is higher endemic diversity in littoral microhabitats compared to sublittoral or profundal regions (Martens 1997). Further, in most cases littoral taxa are also intralacustrine (neo-) endemics, while species living in deeper parts of the lake share morphological characters and are even genetically more closely related to ancestor species (relicto-endemic). There are few to no good examples of total extinction events in ancient lakes (Cristescu et al. 2010).

Diatoms are the most diverse eukaryotic group of organisms in the ancient lakes. Many studies have shown extraordinary diversity in the diatom communities. The level of endemism and biodiversity, vary among ancient lakes, but this is limited by with the number (intensity) of studies in recent times. In the older literature (e.g. Hustedt 1945, Jurilj 1948, 1954) usually a much broader species concept was used, while recently (based on additional techniques such as SEM and molecular studies) this concept has changed comprising a more refined definition of species variation (Levkov et al. 2007; Pavlov et al. 2013). Such changes have resulted with description of many new taxa from the ancient lakes. However, there is still a lack of phenotypic expression and biogeographic data limiting the metrics of species determinations. One of the most diverse genera in the ancient lakes is *Surirella*

Turpin (including *Iconella* Jurilj) with many endemic species (Jurilj 1948) and each lake probably has its own distinctive group of species and/or species flocks (Mackay et al. 2010).

Organisms with complete aquatic life cycles (such as snails, ostracods, copepods...) show higher endemism, while others with only part of the life cycle connected to water habitats (such as insects) have low level of endemism. It is also evident that more basal "primitive" organisms have higher percentages of endemism. For instance triclads (Order: Tricladida) are very diverse in Lake Ohrid (Sapkarev et al. 1998) with 21 recorded species. However, recent detailed investigations are missing or studies on selected species (especially small species) have not been carried out (Abrecht & Wilke 2008). Oligochaetes (Oligochaeta) are common in the benthos and a relatively well studied group of animals in ancient lakes.

Lake Ohrid is characterized by an intermediate diversity and endemism of oligochaetes. However, the main problem is a lack of detailed study of this group. Sapkarev (1964, 1966) listed 17 endemic taxa (below species level) that need to be critically re-checked to properly establish their identity. Gastropods are one group characterized by the highest diversity and endemism in ancient lakes. According to Strong et al. (2008) the gastropod fauna from continental waters comprises ca. 4,000 species; ancient lakes are considered as hotspots of diversity.

Many explanations and hypotheses have been proposed for the high diversities in ancient lakes. In earlier works it was suggested that some of the heavily calcified species might have marine origin. A detailed account on the gastropod fauna of Lake Ohrid is provided by Radoman (1985) who suggested that species might have different origins: (Balkan, European, Middle East and intralacustrine). At present the gastropod fauna comprises 72 species from which 56 are considered as endemic for the lake. The gastropod fauna in Lake Ohrid is characterized by species with peculiar shell characters such as ribs, and scalariform shell shapes (Radoman 1983). Albrecht & Wilke (2008) suggested the presence of several species flocks in the gastropods, indicating intralacustrine speciation and adaptive radiation of the species. Schultheiß et al. (2008) also suggested the presence of phylogenetic relationships for some endemic species with taxa outside the Balkan as noted by Radoman (1985).

The amphipods are a diverse group of animals in the ancient lakes. The amphipod fauna of Lake Ohrid comprises 11 species (Karaman 1987), nine of them are endemic (Sapkarev 1998). Molecular clock analysis shows there were at least two intralacustrine radiations: one estimated at 2–3 Mya and the second at less than 1 Mya. The first radiation might be associated with the origin of the lake and the second with the establishment of the deep phase of the lake (Wysocka et al. 2014). The ostracod fauna in ancient lakes is very diverse and comprise about 20% of known species worldwide. Based on molecular analyses of selected genera the number of species might be twice increased. The ostracod fauna in Lake Ohrid includes 52 species of which 33 are considered as endemic, characterized by an extraordinary range of shell shapes (Albrecht & Wilke 2008).

Some of the endemic species belong to genera predominantly known as salt- and brackish-water taxa. Freshwater sponges are reported to be much younger in origin (48-40 Mya) compared to marine species (500^{+} Mya) (Müller et al. 2007). Endemism and radiation events in freshwater sponge taxa have been recorded in ancient lakes. However, the origin and evolutionary history of freshwater sponges is poorly understood and their biodiversity is probably underestimated. In Lake Ohrid, five species of sponges have been recorded, including two endemic genera: *Ochridaspongia* (represented with two species) and Ohridospongilla (with one species).

In Lake Ohrid 30 endemic species of Ciliophora have been recorded (Stankovic 1960). Many taxa are parasitic and presumably coevolved with their native host, mainly oligochaetes and tricladids (Albrecht & Wilke 2008).

A comprehensive fish inventory and also fish stock assessments have never been performed on Lake Ohrid and still there is a debate about status of some of the salmonid species (Talevski et al. 2009). In general, Lake Ohrid is characterized by the presence of 17 fish species with seven endemic species and six alien species. Alien species amounted to about 15 % in the annual catches (Spirkovski et al. 2018). Salmonidae are represented by two species, while Cypriniformes show the highest diversity in the lake with 12 species. However endemism of this group in the Lake Ohrid is still under discussion, since some of recently were considered to be present in system in entire river Drim watershed (or so called Ohrid–Drim–Skutari system). The fish populations in Lake Ohrid are exposed to various stressors such as environmental pollution and habitat degradation, unsustainable fishery, invasive species (Kostovski et al. 2010).

Ancient lakes hold a surprising high level of species richness and diversity relative habitat availability and niche breath. Most ancient lakes are cradle (sinks) for endemism, while others may also show regional dispersals through time. The oldest lake in Europe, Lake Ohrid has the broadest range of diversity across the biological groups. This is likely a combination of easy access to multiple marine introductions and large niche widths (habitats) for evolutionary development. Further, there has not been any significant mass extinction and the water quality has been stable for much of the lake history.

Lake Ohrid is considered a cradle (taxa refugia) for the northern part of Europe. However, the recent urban development in the area, mass tourism, pollution, eutrophication, habitat destruction and modification, as well introduction of alien species might lead to first large extinction in Lake Ohrid. Situation with biodiversity is not any more alarming, the situation is near catastrophic with tendency to become catastrophic.

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LOWMP Supplement V
Fishery and aquaculture

Fishery and Aquaculture

Fish fauna and stocks

The lake contains significant number of endemic species, with nearest neighbors in Pliocene. The size of Lake Ohrid and the quality of the fish fauna gives to the lake an important significance from the fishery point. The quality and the economic value of the fish populations of Lake Ohrid are on a much higher level than the rest of the Balkan lakes, even above those shallow and high productive ones from the Aegean zone (Stankovic, 1960). The fish fauna is represented with 17 autochthonous species from four families: Salmonidae (2), Cyprinidae (12), Cobitidae (2) and Anguillidae (1) and 6 alochthonous species or in total twenty-one taxa. None of them is migratory species.

Table 1. Lake Ohrid fish species (Presence/Absence in Reference period: L = evidenced by literature; C = evidenced by catch statistics; E = expert judgement)

Species	Scientific name	Presence under reference (undisturbed) conditions	Presence today	Natural reproduction in lake	Abundance class under reference condition	Abundance class today	Comments
Ohrid spirlin	*Alburnoides ohridanus*	L,E	L,E	yes	2	2	Riverine by origin, but adopted to landlock aquateria
Bleak	*Alburnus scoranza*	L, C	L, C, E	yes	3	3	Native, commercial, population expansion – E
European eel	*Anguila anguila*	L, C	L, C	no	1	1	From 1961 artificial stocking, commercial
Stone loach	*Barbatula sturanyi*	L, E	L, , E	yes	1	1	Non commercial
Barbell	*Barbus rebeli*	L, C	L, C, E	yes	1	1	Commercial, banned at Macedonian part
Prussian carp	*Carassius gibelio*	L	L, E	yes	1	1	Introduced from 1983, Commercial
Ohrid nase	*Chondrostoma ohridanus*	L, C	L, E	yes	1	1(0)	Commercial
Spined loach	*Cobitis ohridana*	L, E	L, E	yes	1	1	Non commercial
Carp	*Cyprinus carpio*	L, C	L, C, E	yes	2	2	High commercial
Mosquito fish	*Gambusia holbrooki*	L, E	L, E	yes	1	1	Introduced in 1940's,
Ohrid gudgeon	*Gobio ohridanus*	L, C	L, C, E	yes	2	2	Commercial
Pumpkinseed	*Lepomis gibbosus*	L, E	L, E	yes	1	1	Introduced 1990's,
Rainbow trout	*Oncorhynchus mykiss*	L, C, E	L, E	no	1	1	Firs time introduced in 1970's; from time to time present from the surrounding fish farms in Albania
Ohrid minnow	*Pachychilon pictum*	L, C	L, C, E	yes	3	3	Non commercial
Ohrid minnow	*Pelasgus minutus*	L, C	L, E	yes	1	1	Non commercial
Minnow	*Phoxinus*	L, E	L, E	yes	1	1	Non commercial

	lumaireul						
Stone moroko	*Pseudorasbora parva*	L, C	L, C, E	yes	1	2	Introduced 1970's, Non commercial
Bitterling	*Rhodeus amarus*	L, C, E	L, C, E	yes	1	1	Introduced 1990's
Ohrid roach	*Rutilus ohridanus*	L, C	L, C	yes	3	3	Commercial
Ohrid belvica	*Salmo ohridana*	L, C	L, C, E	yes	2	2	Highly commercial
Ohrid trout	*Salmo letnica*	L, C	L, C, E	yes	2	2	Most high commercial
Rudd	*Scardinius knezevici*	L, C	L, C, E	yes	1	1	Commercial
Ohrid chub	*Squalius (squalus) platyceps*	L, C	L, C, E	yes	2	2	Commercial
Total number	*23*	L, C, E	L, C, E				

Abundance classes: 0 = absent, 1 = rare; 2 = frequent; 3 = abundant)

In the fishery 10 species have commercial value with prior to the two relic and endemic trout - *Salmo letnica* (Karaman) and *Salmo ohridana* (Steind.) - than the European eel *Anguilla anguilla* (L.) the common carp *Cyprinus carpio* (L.) and the bleak *Alburnus scoranza* (Filipi). Also there are several temporary present allochthonous species, among which only *Carassius gibelio* (Bloch) is evident in the fishery catch. According to the previous fishery statistic at the Macedonian part of the lake, for the periods 1930/57 (Stankovic, 1960), 1929/73 (Tocko, 1975), the salmonid fishes and the eel were represented with 45.6% of the mean annual catch where 43% belongs only to *Salmo letnica*. Due to this fact, from the fishery aspect the lake itself was characterized like a typical trout lake. The same statistics were used to estimate the mean annual fish yield per unit of lake's surface and it has a value of cca 9 kg/ha, for the North Macedonia part. This in other hand again shows the scarcity of nutrients in the lake and in the same time its oligotrophic character. All these things make the fishery as an important economy branch in this part of the country. Besides its scientific and economical value Lake Ohrid's fish fauna hasn't been so much investigated in manner of presence of alien species and mainly those recordings have been represented sporadically without any continuous monitoring attention until 2013 and 2015 when more detailed fish monitoring was applied using EN 14757 standard which is part of EU WFD monitoring requirements.

In table 1 two trout species are presented *Salmo letnica* (Lake Ohrid trout) and *Salmo ohridana* (Lake Ohrid belvica) despite the five explained in the literature (Kottelat and Freyhof 2007), since never in the fishery of Lake Ohrid four forms of *Salmo letnica* (*Salmo balcanicus*, *Salmo typicus*, *Salmo aestivalis* or *aphelios* and *Salmo lumi*) were treated as separate species.

As in other fishery intensive exploited water bodies most of the work has been paid to commercially valuable species mainly Lake Ohrid trout, Lake Ohrid belvica, eel, carp and bleak.

The ichthyological investigations were mainly addressed to reproduction of the native species their forage and the relation between cyprinid and salmonid species in the terms of their food competitiveness (zooplanktophagues).

From the data in certain technical report or papers provided for the fishery sector of both countries Albania and North Macedonia changes of the assemblages of the bleak particularly of their winter schooling are quite evident. Normally in front of the villages Trpejca, Pestani, Radozda on North Macedonia side and Lin and Memlisht on the Albanian part of the Lake the bleak was schooling till 2003, after that things were changed – they were not schooling at this places but they were spread all over the lake as in littoral as well in pelagic part.

From other technical and research papers changes in the spawning ecology of the two endemic Lake Ohrid trout were evidenced and recorded due to habitat disturbance, as well as their population size reduction.

Actions that affected the fish populations in the lake

Changes of fish migratory patterns

In the early sixties of the 20th century with the construction of the first dam on the River Drim in then Yugoslavia, permanently was cut the natural migration path of the European eel. Special eel stocking program was established for its population maintenance in the lake with elvers obtained from river estuaries from European sea coast whose performance was obligation of the Electro power enterprise of the Socialist Republic of Macedonia. At present two dams in North Macedonia and 4 in Albania exists, from which 5 of them are high dams of cca 100 meters.

Disruption of the fish spawning grounds

From other hand, connected again with hydropower electricity production with aim to increase the water accumulation capacity with enlarging of the watershed of Lake Ohrid with additional 463 km^2 through the diversion of the River Sateska into the lake, which was naturally a tributary to River Drim, large area of trout spawning grounds on the Northern part of the Lake permanently were devastated due to erosion (siltation) and nutrient load. This area was also one of the most important fishing grounds.

Lately the increased navigation activities, especially at the North Macedonia part of the lake, which is expressed as in large number of speed boats for leisure and commercial transport as well in extended sailing periods during the whole year, and especially close to the shore where most of the fish spawning grounds are located. The boat traffic on the lake has also affected the spatial fish distribution in the pelagic waters during the summer period when the Ohrid trout feeds on zooplankton. Thus the trout is mainly occupying the pelagic waters in Albania (as there isn't such intensity), that is also expressed in the reported fish catch of this species where the ratio is 70:1 in favor for the Albanian part.

The presence of solid waste or litter in the areas of the fish spawning grounds is also hot point in the lake. It is comprised of plastic bags, bottles, various other plastic crashes, other bulky waste like car and truck tires, toilets, cooking stoves, closets, matrasses, metal scraps and a lot of unimaginable things. All of these have different specific impact. This type of litter up to date has been cleaned through numerous voluntary actions of scuba diving clubs, and other domestic and foreign enthusiasts.

Lately, with the usage of nylon gill nets for fishing, huge presence of "ghost nets" has been evidenced. These nets as abandoned, lost, forgotten or other way discarded lie at the lake bottom mainly in the fish spawning areas where they continue fishing from one side and as they are not removed the fish afterward decays which make the rest of the fish to avoid this area for spawning that reduces the fish recruitment. In 2017, within the Project "Conservation and Sustainable use of Biodiversity of Balkan Lakes Prespa, Ohrid and Skadar/Shkodra" the Hydrobiological Institute from Ohrid, realized a Pilot Project for detecting and removing part of this so called "ghost nets", when more than 300 nets were located and 13,4 Km of net length was extracted from the lake's bottom, that is approximately equal to Lake Ohrid width. The assumption is that this is just a small portion of such nets that still lie at the bottom. The whole project and the findings are published in scientific journal.

All of these negative influences have caused tremendous changes in the spawning ecology of the lake's fishes and especially among the trout species. Thus, no longer from the shoreline cliffs is possible to observe the natural Ohrid trout spawning in the upper littoral (0,5 to 5m depth) where on a bottom surface of 100 m^2 approximately 10 trout nests were present. This situation is worsening also by targeted trout fishing.

The last one drastically disrupted the natural everlasting population and ecological niches balance between the Ohrid trout and the bleak. Namely, by extracting huge amount of the trout versus the other fish that led to tremendous reduction of the trout number in the lake as the prime predator fish, that was dominant in the pelagic waters whose pray was the bleak which in the winter period was schooling in natural wintering sheltered places along the shore where in the same time the whole bleak catch was obtained, at present it doesn't do it anymore and it is spread all over the open lake waters as there is no trout to chase it. These conditions killed the bleak fishing.

Alien fish species and fish diseases

There are six introduced (alien) fish species in Lake Ohrid present at the moment. Before World War II and after the War in the combat against the malaria mosquito fish was introduced into Lake Ohrid.

In 1974 the presence of rainbow trout was for the first time recorded in the lake and examples could be found regularly in the fish catch until 1994. Its presence was result of existing rainbow trout farm on the Albanian side, close to the shore, which was closed with joint Albanian-Macedonian experts decision in 1994. This fish farm was converted to a hatchery and nursery of the Lake Ohrid trout fingerlings.

In 1983 evidence of Prussian carp like a new present species in the Lake Ohrid fish fauna was recorded, so in certain years the catch of this species exceeds more than 20 tons annually. In second half of the 90's bitterling was introduced accidently during the transport of the silver carp stocking material for fish farms in Albania. Until now there isn't recorded evidence of symbiotic relations between bitterling and lake shells (clams).

In 2018 and 2019 significant expansion of the invasive pumpkinseed *Lepomis gibbosus* (North American freshwater fish of the sunfish family) was recorded in Lake Ohrid. This fish is present in the neighboring Lake Prespa as well, where in certain years the pumpkinseed had population expansions. The first records of this fish together with the bitterling are dating from the 90ties of the last century.

Concerning fish diseases of Lake Ohrid fish it is generally expressed through presence of some parasites that up to date haven't caused significant fish kills or loss. Significant fish kills have been observed among the lake's eel population which occurs after stocking of the lake with young eels in the past 15 years, which may be a result of inappropriate obtaining of stocking material and quarantine.

Fish stock exploitation

Targeted fish species fishing. At present drastic decline of Lake Ohrid trout is still evident, that started from the beginning of 90's. Both, Lake Ohrid trout and Lake Ohrid belvica due the overfishing and still high fishing pressure are drastically endangered even on the edge of their population recover irreversibility. Despite all the efforts from both countries sharing the lake of improving the Lake Ohrid trout with the joint restocking program, the results cannot be visible due to fishing the non-mature specimens which was registered also with the last surveillance monitoring in 2019. Surprisingly relatively good condition of the trout population in the Rivers Koselska and Sateska, especially in there upper and mid flow was registered.

The population of bleak is in expansion, eel population is maintained with stocking material, carp population shows relative good conditions. It is worth to mention that almost 3 decades the population of undermouth (nase) has been also drastically declined as in the catch as well in previously known habitats. Similar situation was recorded with the barbell population. The rest of the endemic but commercially unvalued species are in a relatively good condition, depending on temporal changes in their habitats.

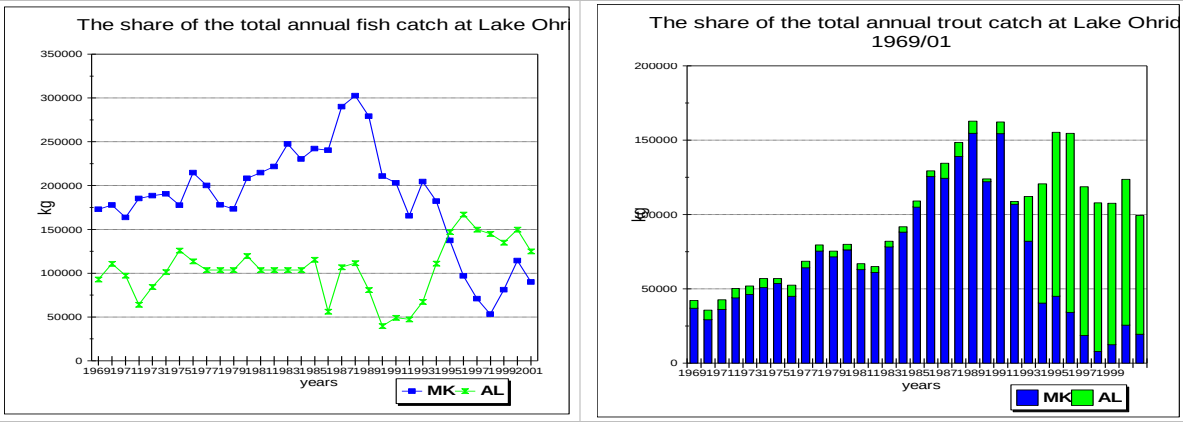
Regarding the alien species rarely specimens of rainbow trout can be found still in the fish catch. The same situation is with the silver carp. The rest of alien species which are minnows and don't appear in the fish catch are still present with different abundance on different habitats, but their impact on the rest of the fish fauna and the rest of the ecosystem hasn't been deeply investigated yet.

When summarized all conditions of the fish population as BQE, the lake itself can be categorized as moderate to poor status whilst the Rivers Koselska and Sateska good. Exception is the River Cerava with bad status.

Exploitation – commercial and recreational fishing

According to recent archeological findings Lake Ohrid represents a cradle of freshwater fishery on the Balkans ranging from the neolith age. But, the first official fishery statistics dates from the year of 1929.
At present, although Fishery Master Plans for Lake Ohrid exists on both sides of the lake adequate fish catch survey, in terms of catch structure (size, weight, age and sex) indicating the main determinants for controlling and proper protection of fishes in the lake, is lacking.

Fig. 4.7 LOW: Share of total annual fish and annual trout catch at Lake Ohrid, 1969 – 2001;
Source: Spirkovski at all., 2002

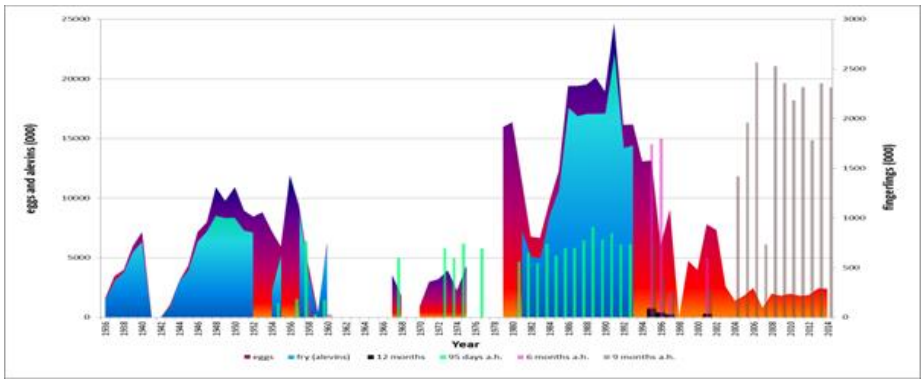


This is mainly a concern for the endemic Salmonid species in the lake – Ohrid Trout and Belvica – that are the main market demanded fish species. Adding poaching (illegal fishing), the pressure to these fishes is increased to the level of possible irreversibility of their populations.

Despite the vast efforts in the restocking of the lake with offspring of Ohrid Trout, which takes part every year on both sides with roughly 3,500,000 individuals for the whole lake, inadequate protection and unsustainable fishing practices are pushing towards inevitable further population destruction of these two fish species.

Fig. 4.8 Lake Ohrid trout restocking on the North Macedonia side of the lake

Source: HBI Ohrid Statistics



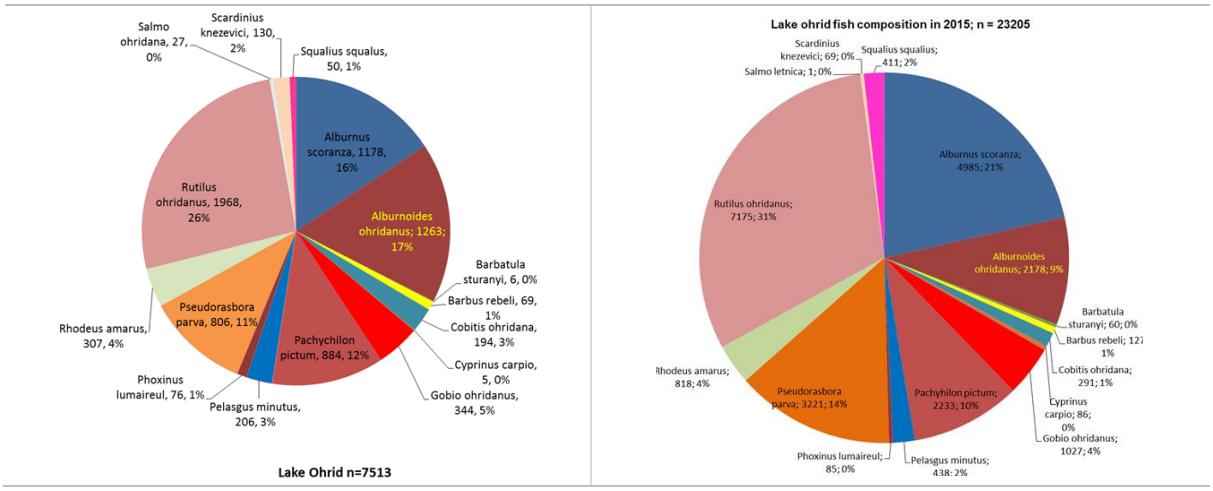
Lake Ohrid has in the past has been described as salmonid water. Yet, recent findings show that the lake is dominated by cyprinid species, both in terms of numbers and biomass. On the other hand, the destruction of salmonid species favors the bleak (small fish with biggest abundance in the lake), which in shortage of trout as a predator spreads all over the lake spatially and temporally, invading new ecological

niches in the lake (e.g. pelagic) previously reserved for the trout. Thus, the common nutritive component for these two fish species – the zooplankton – becomes more affordable for the bleak unlike previously for the trout. Further, the misbalanced trout:bleak ratio also contributes to worsening of the water quality, in particular due to increased presence of excretive metabolites from the bleak that differ from the trout ones. Hence, very low exploitation of the bleak is just worsening the ecosystem characteristics.

Table 2: Commercial fish catch 2010 - 2016

Lake Ohrid - Fish Species and Catch (t)																
Fish species	**Albania**					**FYR Macedonia**					**Total**					**%;**
Common name	**2010**	**2011**	**2012**	**2013**	**2014**	**2012**	**2013**	**2014**	**2015**	**2016**	**2012**	**2013**	**2014**	**2015**	**2016**	**(2014)**
Lake Ohrid trout	51.0	52.0	50.5	50.0	51.8	0.2	0.9	1.1	0.7	0.3	50.7	50.9	52.9			28.9%
Belvica	12.0	11.0	11.7	12.0	12.5	1.0	8.0	14.7	17.1	17.4	12.7	20.0	27.2			14.9%
Carp	5.0	4.4	4.2	4.0	4.9	3.6	14.3	21.7	11.3	5.2	7.8	18.3	26.6			14.6%
European eel						0.2	1.1	1.1	0.2	0.0	0.2	1.1	1.1			0.6%
Bleak	57.0	55.0	54.9	58.0	56.1	3.6	5.0	5.7	0.0	0.1	58.5	63.0	61.8			33.9%
Roach						0.0	0.6	0.0	0.0	0.0	0.0	0.6	0.0			0.0%
Chub	4.8	5.7	5.0	4.2	6.5	0.5	3.1	3.1	1.1	0.9	5.5	7.3	9.6			5.3%
Rudd						0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0			0.0%
Barbel						0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0			0.0%
Prussian carp	2.7	2.9	3.4	3.0	3.2	1.0	0.4	0.3	0.0	0.0	4.4	3.4	3.5			1.9%
Total (t)	**132.5**	**131.0**	**129.7**	**131.2**	**135.0**	**10.1**	**33.4**	**47.6**	**30.7**	**23.9**	**139.8**	**164.6**	**182.6**	**0.0**	**0.0**	**100%**

Fig. 4.9 LOW: Fish species composition in Lake Ohrid, 2013 and 2015 sampling campaigns
(Aliens Pseudorasbora parva and Rhodeus amarus represented with 15% in 2013 and 19% in 2015)



Fishery management and legislation

Both riparian countries have legislative documents for fishery management on Lake Ohrid, but they are not harmonized in many aspects. This concerns the allowable fishing quotas per fish species, minimum allowable catch size of the fishes, period of bans during natural reproduction, fishing gears, number of fishers for commercial fishing and other bay low regulations. The number of allowed fishermen in Albanian part of the lake is 208 whilst on the North Macedonia 57. Hence, urgent synchronizing of the fishing regulations is a must by creating Joint Fishery Management Plan for Lake Ohrid.

In the North Macedonian part of Lake Ohrid Watershed farming of nonnative fishes is not allowed, whilst in the Albanian part still exist some rainbow trout farming. The specimens of rainbow trout present in the lake originate from the escapements of these farms.

Abstraction of surface water and diffuse pollution from aquaculture

At present the main abstraction of surface water for aquaculture takes place at the two hatcheries (trout restocking fish farms) in Ohrid (HBI) and Lin, as well as at three small fish farms in the Albanian part of the

lake. The total extracted water volume equals roughly 2.5 mill m^3/year, but it cannot be consider affecting the water inflow to the lake as the same amount flows back to it.

Diffuse pollution from aquaculture, although at a minimal level, is a result of the presence of both restocking fish facilities in Ohrid (HBI site) and Lin. The amount of food (nutrient load) used for these aquaculture facilities is minimal, at roughly 3,000 kg/year at each site. There are no other fish farms (cages) in the lake at present. On the other hand, diffuse pollution from other activities (e.g. agriculture) expressed in agrochemical load in the lake affects the fish fauna in various manners. Of particular importance in this regard is the presence of pesticides and herbicides, which harm the fish physiology, result in metabolism changes and worst in genetic changes – masculinization or feminization of the opposite genders.

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