

2nd River Basin Management Plan Drin-Buna River Basin 2027 - 2032

Main Report

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DOCUMENT OVERVIEW

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LIST OF ACRONYMS AND ABBREVIATIONS

a.s.l.	Above Sea Level
ADA/ADC	Austrian Development Agency / Austrian Development Cooperation
AGS	Albanian Geological Survey
AKUK	National Agency for Water Supply and Sewerage
AKUM	Agency for Water Supply, Sewerage and Waste Management
ASIG	State Authority for Geospatial Information
ASPT	Average Score Per Taxon
AWB	Artificial Waterbody
BGL	Background Level
BM	Basic Measures
BOD5	Biochemical Oxygen demand, five days
BQE	Biological Quality Element
CA	Competent Authority
CEMSA	Consolidation of the Environmental Monitoring System in Albania
CEN	European Committee for Standardization
CIS	Common Implementation Strategy
CODCR	Chemical Oxygen Demand, dichromate method
CWB	Coastal Waterbody
CZMP	Coastal Zone Management Plan
DCM	Decision of the Council of Ministers
DPSIR	Drivers, Pressures, State, Impact, and Response model
DSIP	Directive Specific Implementation Plan
DWD	Drinking Water Directive
DWPA	Drinking Water Protected Area
EC	European Commission
EEA	European Economic Area includes all 27 EU member countries along with three non-EU countries: Iceland, Liechtenstein, and Norway.
EF	Environmental Flow
EIA	Environmental Impact Assessment
EO	Environmental Objective
E-PRTR	European Pollutant Release and Transfer Register
EQR	Environmental Quality Ratio
EQS	Environmental Quality Standard
EQSD	EU Environmental Quality Standards Directive
EU	European Union
EU4RIVERS	Austrian Development Agency (ADA), as the Operational Unit of the Austrian Development Cooperation (ADC), has been delegated by the European Union (EU) to implement the "EU4Rivers" project in Albania from October 2023 to September 2028. The lead Beneficiary is the Albanian Water Resources Management Agency (WRMA / AMBU).
EUSIWM	European Union Support to Integrated Water Management
FD	EU Floods Directive
FD	EU Floods Directive
FDC	Flow Duration Curve
FRMP	Flood Risk Management Plan
GC/MS	gas chromatograph / mass spectrometer
GD	EU Groundwater Directive
GDP	Gross Domestic Product
GEP	Good Ecological Potential
GES	Good Ecological Status
GIS	Geographical Information System
GMU	Groundwater Management Unit
GWB	Ground Waterbody
GWDTEs	Groundwater Dependent Terrestrial Ecosystem

HMQI	Hydro-Morphological Quality Index
HMWB	Heavily Modified Waterbody
HPP	Hydropower Plant
I&D	Irrigation & Drainage
IBA	Important Bird and Biodiversity Area
IED	Industrial Emissions Directive
IGEO	Institute of Geosciences
INSPIRE	EU directive on Infrastructure for Spatial Information in the European Community
IPH	Institute for Public Health
IPMG - IWM	Integrated Policy, and Management Group for Integrated Water Management
IPPC	EU Integrated Pollution Prevention and Control Directive
ISO	International Organization for Standardization
IWRM	Integrated Water Resources Management
KBA	Key Biodiversity Area
KESH	Albanian Power Corporation / Korporata Elektroenergjitike e Shqipërisë
KTM	Key Type of Measures
KTP	Key Type of Pressures
LGU	Local Government Unit
LHCU	Local Health Care Unit
LIWRM	Law on Integrated Water Resources Management – Law N° 111/2012
MARD	Ministry of Agriculture and Rural Development
MD	Ministry of Defence
MFE	Ministry of Finance and Economy
MHSP	Ministry of Health and Social Protection
MIE	Ministry of Infrastructure and Energy
MOE	Ministry of Environment
MOM	Management, Operation and Maintenance
MOTE	Ministry of Tourism and Environment
MQI	Morphological Quality Index
MSFD	Marine Strategy Framework Directive
NAP	National Adaptation Plan
NAPA	National Agency of Protected Areas
NCTW	National Council of Territory and Water
ND	Nitrates Directive
NEA	National Environment Agency
NECP	National Energy and Climate Plan
NEIP	National European Integration Plan 2022–2024
NGO	Non-Governmental Organisation
NH₄	Ammonium (NH ₄ ⁺)
NO₂	Nitrite (NO ₂ ⁻)
NO₃	Nitrate (NO ₃ ⁻)
NSIWRM	National Strategy for Integrated Water Resources Management
NSPA	Nutrient Sensitive Protection Area
NVZ	Nitrate Vulnerable Zone
NWRC	National Water Resources Cadastre
P.E.	Population Equivalent
PA	Environmental Protected Areas
PAH	Polycyclic Aromatic Hydrocarbons
PMO	Prime Ministers Office
PO₄	Orthophosphate (PO ₄ ³⁻)
POM	Programme of Measures
PTOT	Total Phosphorus
QA/QC	Quality Assurance / Quality Control
RB	River Basin
RBAO / ZABU	River Basin Administration Offices

RBC	River Basin Council
RBD(A)	River Basin District (Authority)
RBM	River Basin Management
RBMP	River Basin Management Plan
RBPA	Recreational or Bathing Water Protected Area
RWDB	Regional Water Drainage Board
SDG	UN Sustainable Development Goals
SEA	Strategic Environmental Assessment
SM	Supplementary Measures
STPS	Standard Technical Procedures
SUDS	Sustainable Urban Drainage System
SWB	Surface Waterbody
SWMI	Significant Water Management Issues
TDA	Transboundary Diagnostic Analysis
UWWTD	EU Urban Wastewater Treatment Directive
WAFU	Water Availability for Use (by operators)
WBMO	Water Basin Management Office
WFD	EU Water Framework Directive
WRA	Water Regulatory Authority
WRMA / AMBU	Water Resources Management Agency
WTP	Water Treatment Plant (for public water supply)
WUA	Water Users Association
WWTP	Wastewater Treatment Plant

GLOSSARY OF SELECTED TERMS

- **Aquifer** means a subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
- **Background Levels (BGLs)** represent the natural concentration of substances in groundwater that are not, or only minimally, influenced by human activities.
- **Body of groundwater** means a distinct volume of groundwater within an aquifer or aquifers.
- **Body of surface water** means a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water, or a stretch of coastal water.
- **Ecological status** is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters.
- **Emission controls** are controls requiring a specific emission limitation, for instance an emission limit value, or otherwise specifying limits or conditions on the effects, nature or other characteristics of an emission or operating conditions which affect emissions.
- **Emission limit values** mean the mass, expressed in terms of certain specific parameters, concentration, and/or level of an emission, which may not be exceeded during any one or more periods of time.
- **Environmental Quality Standard (EQS)** defines the concentration threshold for a specific pollutant in water, sediment or biota that must not be exceeded to protect human health and the aquatic environment. EQS are used for the assessment of chemical status.
- **Ecological Quality Ratio (EQR)** expresses the deviation of observed biological conditions from the relevant type-specific reference conditions on a scale from 0 to 1. EQRs are used for the assessment of ecological status based on biological quality elements. In summary, EQS relates to chemical compliance, whereas EQR relates to ecological condition.
- **Good groundwater status** means the status achieved by a groundwater body when both its quantitative status and its chemical status are at least 'good.'
- **Good surface water status** means the status achieved by a surface water body when both its ecological status and its chemical status are at least 'good.'
- **Groundwater** means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.
- **Groundwater status** is the general expression of the status of a body of groundwater, determined by the poorer of its quantitative status and its chemical status.
- **Hazardous substances** mean substances or groups of substances that are toxic, persistent, and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern.
- **Heavily modified water body** means a body of surface water which because of physical alterations by human activity is changed in character.
- **Inland water** means all standing or flowing water on the surface of the land, and all groundwater on the landward side of the baseline from which the breadth of territorial waters is measured.
- **Lake** means a body of standing inland surface water.
- **Pollution** means the direct or indirect introduction, as a result of human activity, of substances or heat into the air, water or land which may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems, which result in damage to material property, or which impair or interfere with amenities and other legitimate uses of the environment.
- **Priority hazardous substances (PHS)** are the most dangerous subset of Priority Substances recognized for properties such as being toxic, persistent, and bioaccumulative (PBT), or very persistent and very bioaccumulative (vPvB).
- **Priority substances** are a list of chemical substances that pose a significant risk to aquatic ecosystems and human health.
- **River basin district** means the area of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters as the main unit for management of river basins.
- **River basin** means the area of land from which all surface run-off flows through a sequence of streams, rivers, and lakes into the sea at a single river mouth estuary or delta

- **River** means a body of inland water flowing on the surface of the land, but which may flow underground for part of its course.
- **SPI** is a drought indicator based only on precipitation. It shows whether a period was wetter or drier than normal compared with the long-term average. A negative SPI means dry conditions; a positive SPI means wet conditions. SPI is useful to detect rainfall deficits, but it does not include temperature or evaporation.
- **SPEI** is similar to SPI, but it also includes the effect of temperature and evapotranspiration. It compares precipitation with the atmospheric water demand. When temperatures rise, evaporation increases, and soils, rivers and reservoirs can become drier even if rainfall does not change much. SPEI is therefore better suited to assess drought under climate change.
- **Sub-basin** means the area of land from which all surface run-off flows through a series of streams, rivers, and lakes to a particular point in a water course (normally a lake or a river confluence).
- **Surface water** means inland waters, except groundwater; transitional waters and coastal waters, except in respect of chemical status for which it shall also include territorial waters
- **Surface water status** is the general expression of the status of a body of surface water, determined by the poorer of its ecological status and its chemical status.
- **Transitional waters** are bodies of surface water in the vicinity of river mouths which are partly saline in character because of their proximity to coastal waters, but which are influenced by freshwater flows.

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EXECUTIVE SUMMARY

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How the Plan was developed

The water bodies and protected areas of the basin

The main water management issues

Main pressures and status findings

The Programme of Measures

Economic and institutional implications

The way forward

1 Introduction, Institutional Context and Framework of Legal Acts, Policies and Plans

This chapter provides an overview of the institutional and legal framework governing water management in Albania. It describes the roles and responsibilities of key authorities and stakeholders and summarises the national and basin-level legal acts relevant to water, environment, and land use. The section situates the RBMP within broader policy frameworks, including national strategies for environment, climate, and agriculture, and identifies opportunities for policy coherence and integration.

1.1 Introduction

The Second River Basin Management Plan (RBMP) of the Drin-Buna River Basin sets out the framework for the management of surface water bodies, groundwater bodies, and protected areas. It supports the implementation of Albania's national water legislation, including Law No. 29/2024 on Water Resources, and aligns with the objectives and procedures of the EU Water Framework Directive (WFD, Directive 2000/60/EC) and its related directives.

The WFD aims to prevent deterioration and to protect, enhance and restore all waters, with the objective of achieving good status for surface waters and groundwater. For surface waters, good status combines ecological and chemical status. For groundwater, it combines quantitative and chemical status. Water quantity, including flows and volumes, is addressed where it directly supports water quality, ecological status, environmental flows, and the sustainable use of water resources.

The RBMP is the main planning instrument for integrated water management in the Drin-Buna River Basin. It provides the technical and policy basis for assessing water body status, identifying pressures and impacts, defining environmental objectives, and selecting the measures needed to achieve or maintain good status. The plan includes:

- a general description of the Drin-Buna River Basin, including hydrology, meteorology, land use, and water use;
- the delineation and typology of rivers, lakes, transitional waters, coastal waters, and groundwater bodies;
- the identification of reference conditions and environmental objectives for water bodies;
- the assessment of current ecological, chemical, quantitative, and hydro morphological conditions;
- the identification of protected areas where water has a specific use or ecological importance;
- an overview of significant anthropogenic pressures and impacts on surface water and groundwater;
- a summary of measures required to address water bodies that do not meet good status or good ecological potential;
- the justification for Artificial Water Bodies and Heavily Modified Water Bodies where good ecological status cannot be achieved because of substantial physical modification;
- an economic analysis of water use, including cost recovery and long-term water supply and demand considerations;
- links with more detailed plans for sub-basins, sectors, water categories, or specific management issues;
- a summary of public consultation and how consultation outcomes have informed the Plan;
- an overview of the competent authorities and their responsibilities; and
- a register of significant water abstractions and related permits where these may affect water body status.

This Second RBMP covers the six-year planning period 2027–2032, consistent with the WFD planning cycle and Albania's ongoing alignment with the EU water acquis. Once adopted by the competent national authorities, the Programme of Measures forms the operational basis for achieving the environmental objectives of the RBMP. These measures guide the actions of competent authorities, operators, and other stakeholders responsible for water management in the Drin-Buna River Basin.

The environmental objectives of the RBMP aim to prevent deterioration, protect water resources, improve and restore the status of surface water bodies and groundwater bodies, and ensure that protected area objectives are met. In this way, the Drin-Buna RBMP provides the central framework for WFD-compliant, integrated, and accountable water management in the basin.

1.2 Institutional and Strategic Context of Water Resources Management in Albania

Albania is committed to an integrated water management approach aligned with the EU's legal and policy framework. Since 2014, the Government of Albania has adopted a vision rooted in the principles of sustainability, equitable access, economic prioritisation, and the long-term protection of ecosystems. The 'Integrated Water Resources Management (IWRM) Strategy 2018–2027' articulates this vision: *"By 2027, Albania shall ensure efficient use of water through integrated and operational water resources management, supported by a complete monitoring system and effective management of flood risks and water scarcity. This will be guided by the principles of equity, sustainability, and environmental justice for present and future generations."*

The 'National Sectoral Program for Integrated Water Management 2021-2027 (NSWRM)' in Albania aims to enhance water resource management through a coordinated approach that addresses various challenges such as scarcity and pollution. It promotes sustainable practices and cross-sectoral collaboration to ensure water security and ecosystem protection.

To lead this agenda, the Integrated Policy, and Management Group for Integrated Water Management (IPMG-IWM), chaired by the Council of Ministers, a central executive body oversees policy development, implementation, and evaluation. The Water Resources Management Agency (WRMA / AMBU), established in 2018, plays a central role in steering water policy and serves as the Council of Ministers secretariat. The IPMG-IWM operates through two thematic working groups: one on water and wastewater reform (led by the Ministry of Infrastructure and Energy), and the other on water resource management (led by WRMA / AMBU). This integrated framework is also embedded in the National European Integration Plan 2022–2024, further aligning Albania's water governance with EU accession priorities.

Administration and management structures for water management are provided at national, basin and local level. The Figure below presents the current relationship between national ministries, basin cooperation, and local agencies. Albania is divided into seven river basins, each one having a River Basin Council (RBC). This structure is favourable, in principle, to counteract the current fragmentation of water resources management and promote an effective administration at basin and local level.

Figure 1 - Organizational chart for institutional framework on water resources management in Albania

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1.3 Competent Authorities and Institutional Responsibilities for Water Resources Management in Albania

This paragraph provides an overview of the main institutions responsible for water resources management in Albania, including their mandates related to surface and groundwater, water quality, and quantity, organized by national, basin, and local levels. It also outlines the key legal and regulatory framework underpinning their responsibilities.

The relevant institutions at **national level** involved in IWRM and the RBM process in Albania for all river basins are summarized here:

COMPETENT AUTHORITY (national level)	MAIN ACTIVITIES CONTRIBUTING TO IWRM & RBM	COORDINATION MECHANISMS
Council of Ministers	Serves as the inter-ministerial coordination body guiding policy development through the Integrated Policy and Management Group (IPMG-IWM).	Crosscutting – policy coordination
Agency for Water Resources Management (WRMA / AMBU / RBAO), under the Ministry of Environment Law 29/2024 "On Water Resources" amended Law 15/2024 MSFD DCM Nr. 335 dated 2025 on "Establishment of WRMA / AMBU"	- Develops water policy and aligns national legislation with the EU WFD; - Implementation and coordination of the Law on Water Resources; - Implementation and coordination of the EU WFD; - Preparation of IWRM Strategy; - Preparation of River Basin Management Plans and respective AP; - Preparation of Flood Risk Management Plans; - MSFD by the law; - Issuing water use permits and authorization (surface & groundwater); - Holder of the Register of Water Abstractions (in NWRC) surface water; - Secretariat of the Council of Ministers.	- Implementation of RBMP and respective PoM. - Implementation of National IWRM Strategy - Implementation of FRMP - Implementation of MSFD - Maintenance of the register of water resources operators - Upgrading and maintenance of the National Water Resources Cadastre
Ministry of Agriculture and Rural Development (MARD)	- Plans and implements agricultural water use; - Management of the large Irrigation and Drainage (I&D) systems; - Responsible for overall policymaking, investment coordination, and donor engagement in the I&D sector; - It provides guidelines and monitors large-scale rehabilitation efforts; - It oversees the performance of Regional Water Drainage Boards (RWDBs).	
Ministry of Infrastructure and Energy (MIE)	- Leads infrastructure development for water supply and sanitation, energy production; - Coordinates reforms in the water services sector.	
Ministry of Environment (MoE)	- Develops environmental and water policies and aligns national legislation with the EU environmental and water related directives; - Oversees environmental standards and permitting;	

	Responsible for monitoring of environmental condition in permitted environmental permits.	
Regional Water Drainage Boards Law Nr. 24/2017 on "Irrigation and drainage" DCM Nr. 437 dated 17.5.2017 on "Establishment of 4 regional directorates for irrigation and drainage"	- Reforms in December 2015 consolidated 13 previous irrigation and drainage boards into four Regional Drainage Boards, each covering major agricultural lowland areas: Lezhë, Durrës, Fier and Korçë. - Management, Operation and Maintenance (MOM) of main irrigation and drainage canals, pumping stations and flood protection infrastructure; - Flood risk management in lowland agricultural zones; - Technical support to municipalities on water infrastructure; - Emergency response in case of flooding or excessive rainfall; - Planning rehabilitation interventions in irrigation, drainage, and flood protection infrastructure; - Monitoring and reporting on the functional status of the drainage network.	Uploading required data to the NWRC, necessary for WRMA / WRMA / AMBU in preparation of RBMP
National Environmental Agency (NEA) Law Nr. 10431 dated 9.6.2011 on "Environmental Protection" DCM Nr. 568 dated 17.7.2019 on "Establishment of NEA"	- National Environmental Monitoring of River Waterbodies - National Environmental Monitoring of Lake Waterbodies - National Environmental Monitoring of Coastal Waterbodies - Environmental Permits (related to the water discharge), issued for all industrial activities in the country - EIAs and SEA assessed regularly	- Publication of the National Environmental Monitoring Programme (yearly exercise) - Maintenance of Register of Environmental Permits - Maintenance of the Register of Pollutant release and discharges
Department of Climate and Environment, Institute of GeoSciences, (IGEO) Law Nr. 8485 dated 12.5.1999 on "Code of administrative procedures" DCM Nr. 490 dated 6.7.2011 on "Establishment of IGJEUM / IGWEWE (merging previous existing different institutions).	- Data collection, verification, and distribution of meteorological data (precipitation monitoring) - Data collection, verification, and distribution of hydrological data (flow monitoring)	- Publication of Climate Monthly Bulletin via website - Uploading required data to the NWRC, necessary for WRMA / AMBU in preparation of RBMP
National Agency for Protected Areas Law Nr. 81/2017 on "Protected areas" DCM Nr. 102 dated 4.2.2015 on "Establishment of national agency for protected areas", as amended in 2016.	- Management of Protected Areas - Implementation of the EU Birds and Habitats Directives. - Responsible for conducting Environmental Impact Assessments (EIA). - Responsible for conducting Strategic Environmental Assessments (SEA).	- Publication of management plans for protected areas, all types - Maintenance of register for protected areas – GIS based - Maintenance of the national Inventory of flora and fauna - Uploading required data to the NWRC, necessary for WRMA / AMBU in preparation of RBMP
National Coastline Agency Law Nr. 93/2015 on "Tourism" DCM Nr. 569 dated 17.7.2019 on "Establishment of national coastline agency"	- Protection and development of sustainable environment in coast - Monitoring and control of illegal touristic-based activities in coast (beaches)	- Maintenance of national inventory of coastline - Monitoring implementation of territorial planning instruments
National Territorial Planning Agency Law Nr. 107/2014 on "Territorial development and planning". DCM Nr. 427 dated 8.6.2016 on "Establishment of national agency for territorial planning"	- Preparation of territorial management plans in a coordinated manner – through local governments - Preparation of integrated plans thematic-wise (including	- Publication of National Development Plan - Coordinate preparation of local governments territorial management plans

	infrastructure, floods, water, agriculture, urban development, etc), considering RBMP	- Publication of Integrated Cross-Sectorial Coastline Plan – GIS based (https://geoportal.asig.gov.al/map/?fc_name=Bregdeti_5_Sistemi_ujor&auto=true) - Publication of Integrated Cross-Sectorial Coastline Plan for Tirana-Durres Region – GIS based (including Tirana, Durrësi, Kamza, Vora, Shijaku and Kruja municipalities). - Maintenance of an Integrated Planning Database.
Albanian Geological Survey (AGS) Law Nr. 111/2015 dated 15.10.2015 on "Albanian geological survey"	- Study and monitoring of groundwater, aquifers, geological layers, hydrogeology. - Hydrogeology study of the rivers including geology of riverbed.	- Publication of reports on groundwater quality - Maintenance of database – GIS based – on geology, hydrogeology, and groundwater aquifers. - Uploading required data to the NWRC, necessary for WRMA / AMBU in preparation of RBMP. - Member of EuroGeoSurveys, since 2007
National Agency for Nature Resources Law Nr. Nr. 7/2017 on "Use of renewable resources" DCM Nr. 547 dated 9.8.2006 on "Establishment of AKBN) as amended in 2017	- Maintenance of database – national – on Energy sector use / capacity - Monitoring and inspection of energy sector + fuels, oils, and all other natural resources - Preparation of national action plan on use of renewable resources for energy production – every 2 years - Approval of Hydropower plants design and monitoring - Analysis of minerals	- Publication of Bulletin on hydropower potential / investments in the country - Maintenance of GIS based system on energy - Uploading required data to the NWRC, necessary for WRMA / AMBU in preparation of RBMP.
National Agency for Water Supply, Sewerage (AKUK) Law Nr. 8102, dated 28.3.1996 on "water supply and sewerage", as amended by law nr. 9915 dated 2008. (the new draft law is prepared – not yet adopted). DCM Nr. 431 dated 11.7.2018 "on establishment of AKUM"	- Implementation of policy and strategy on water supply and sewerage (Master plan for WSS and Waste) - Wastewater treatment - Planning infrastructure for waste - Planning investment needs for water supply / wastewater and waste management considering RBMP	- Maintenance of national GIS platform on water supply and sewerage assets - Publication of reports / statistics on performance of water utilities - Uploading required data to the NWRC, necessary for WRMA / AMBU in preparation of RBMP
National Forestry Agency Law Nr. 90/2012 on "Public administration" DCM Nr. 570 dated 17.7.2019 on "Establishment of NFA"	- Prepare inventory of forestry - Preparation of GIS based maps - Implementation of yearly monitoring programme for forestry, biodiversity, habitats, etc. - Monitoring / control / inspection	- Maintenance of integrated system on forestry (register, database, GIS system) - Publication of reports on status of forestry and other data / information related
National Agency for Civil Protection (former General Directorate for Civil Emergencies) Law Nr. 45/2019 dated 18.7.2019 on "Civil Protection"	- Preparation of national strategy for remediation of risk from disasters - Preparation of national plan for civil emergencies, considering respective RBMP. - Interventions in infrastructure in the damaged areas	- Maintenance of database of information on losses and damages - Establishment of the Fund for Solidarity
State Authority for Geo-Spatial Information Law Nr. 72/2012 dated 28.6.2012 on "organisation and functioning of the state infrastructure for geo-space information"	- Implementation of INSPIRE Directive requirements - Preparation of National Standards for geo-Spatial information - Preparation of all thematic-wise maps, at GIS system	- Publication of all typology / sector maps at local/region/country level - Maintenance of National GIS system for all types of information - Maintenance of the National Geo-Portal (website) with information thematic-wise and available for public

Institute of Public Health Law Nr. Nr.10 138, dated 11.5.2009 on "public health"	• Quality assessment of drinking water (analysis of surface water, groundwater, and water treatment facilities) • Monitoring drinking water quality • Data analysis	• Publication of reports on health issues / status • Publication of health medical Journal • Publication of Bulletin of Health via website. Uploading required data to the NWRC, necessary for WRMA / AMBU in preparation of RBMP,
National Agency for Waste Economy DCM No. 132, date 06.03.2024	• Integrated waste planning, territorial planning of waste infrastructure, environmental education, prepare waste management plans, investments on treatment facilities, etc. considering RBMP.	

The relevant institutions at **basin level** involved in IWRM and the RBM process in Albania for all river basins are summarized here:

COMPETENT AUTHORITY (basin level)	MAIN ACTIVITIES CONTRIBUTING TO IWRM & RBM	MEMBERS
River Basin Council (RBC) is the key governance body responsible for ensuring sustainable water resource management within Albania's river basins. Operating under national legislation and EU WFD principles, RBCs apply Integrated Water Resources Management (IWRM) through the River Basin Management Plan (RBMP).	Water resources management and protection: • Ensure the conservation and sustainable use of water resources within the river basin, aligning with the River Basin Management Plan (RBMP). • Facilitate the fair allocation of water resources, balancing various uses while promoting efficiency and sustainability. • Safeguard water resources against pollution, over-extraction, and degradation. Regulation and decision-making: • Referring to the technical report prepared by WRMA / AMBU, grant or deny authorizations and permits for activities impacting water resources, ensuring compliance with legal and environmental sustainability requirements. Monitoring, implementation, and strategic planning presented by WRMA / AMBU / RBAO: • Review and approve annual implementation reports for RBMPs and Flood Risk Management Plans. • Endorse action plans for the upcoming year, ensuring alignment with national and EU water management priorities.	Chaired by the Prefecture of the main region, RBCs include representatives from: • Municipalities (local governments); • Regional Environmental Agencies; • Water Supply & Sanitation Utilities; • Agricultural & Industrial Stakeholders; • Civil Society Organizations (CSOs) & Academia; • Hydropower Operators (where applicable).

The relevant institutions at **local level** involved in IWRM and the RBM process in Albania for all river basins are summarized here:

COMPETENT AUTHORITY (local level)	MAIN ACTIVITIES CONTRIBUTING TO IWRM & RBM	COORDINATION MECHANISMS
Municipalities	Since the 2015 administrative reform, municipalities are legally responsible for the operation and maintenance of primary and secondary irrigation and drainage systems within their authority.	
Public Utilities (Water and Sewerage Enterprises)	Operate and maintain municipal water supply and wastewater systems.	
Water Users Associations (WUAs)	These used to be farmer-based organisations managing the tertiary irrigation network and water distribution at the farm level. They also should collect water fees and conduct minor maintenance works. Unfortunately, the functioning of the WUA's has collapsed in Albania. Only in Berat, a WUA is still in function. Farmers tend to operate as individual entrepreneurs and do not wish to go back to the collective farming practices of the communist era.	

The institutional roles and responsibilities are grounded in the following legal instruments:

- New Law on Water 2024.
- DCM 345, date 22.05.2019, "For Approval of National Strategy for Irrigation and Drainage and Action Plan 2019-2031".
- The National Sectoral Program for Integrated Water Management 2018-2030".
- Law No. 111/2012 "On Integrated Water Resources Management" (primary water law aligned with EU WFD). (revised 2018).
- Decision of Council of Ministers No. 267 dated 7.4.2021: Establishes the roles of WRMA / AMBU and river basin agencies.
- DCM No 246, date 30.04.2014, "For the determination of environmental quality standards for surface waters".
- Law No. 10431/2011 "On Environmental Protection", amended.
- Law No. 8102/1996 "On Water Supply and Sanitation Sector Regulation".
- National Water Strategy 2018–2027 and accompanying implementation plans.
- National European Integration Plan 2022–2024 (NEIP), integrating water policy under EU approximation.

1.4 Water Framework Directive and Subsidiary Plans

1.4.1 Introduction

The WFD allows River Basin Management Plans to be supported by more detailed programmes and management plans for sub-basins, sectors, specific management issues, or water categories. These subsidiary plans may address aspects of water management in greater detail, but they do not reduce or replace the obligations set out in the WFD.

For the Drin-Buna River Basin, the RBMP provides the core planning framework. Additional strategies or plans may support its implementation if they remain consistent with the environmental objectives of the RBMP. These plans may include, for example, water resources management plans, flood risk management plans, drought risk management plans, coastal zone management plans, and strategic environmental assessments.

Some of these planning instruments are explicitly linked to EU legislation, such as the Directive 2007/60/EC (the Floods Directive). Others follow EU policy and international good practice, for example planning for water scarcity and drought. The RBMP should cross-reference these subsidiary plans where they affect, or are affected by, the environmental objectives for surface water bodies, groundwater bodies, and protected areas.

Any scheme or activity proposed under a subsidiary plan must take account of WFD objectives. Where a project may adversely affect water body status, the responsible authority must either apply adequate mitigation measures to prevent deterioration and maintain ecological status or demonstrate that the beneficial objectives of the modification cannot be achieved by other technically feasible and significantly better environmental options without disproportionate cost. This requirement is particularly relevant for flood protection works, hydropower development, water abstractions, reservoir operation, coastal infrastructure, and river engineering works.

1.4.2 Water Resources Management Plan

A Water Resources Management Plan should support the RBMP by setting out how surface water and groundwater resources are assessed, allocated and managed for long-term sustainability. It should include basin and sub-basin water balances, abstraction registers, management controls, environmental flow requirements, and protection measures.

Although the WFD originally treated water quantity as a supporting element for ecological status, EU guidance now recognises that flow regime plays a central role in the structure and functioning of aquatic ecosystems. Abstractions for irrigation, public supply, industry, and hydropower can significantly alter flow regimes and environmental flows. Good status is therefore unlikely to be achieved unless the flow regime remains sufficiently close to natural conditions, or unless appropriate mitigation measures are implemented.

In the Drin-Buna River Basin, sustainable water resources management must address both ecosystem needs and the requirements of agriculture, hydropower, public water supply, and other users. Measures to improve water efficiency may create benefits or trade-offs across sectors, particularly between irrigation and hydropower. The Water Resources Management Plan should therefore support integrated allocation, efficient use, and transparent decision-making, while safeguarding the environmental objectives of the RBMP.

1.4.3 Flood Risk Management Plan

Floods can endanger lives, damage infrastructure, and cause major economic losses. Flood protection measures are costly and cannot be implemented across the entire basin. Flood risk management must therefore apply a risk-based approach that identifies priority areas and assesses the costs and benefits of potential measures.

The EU Floods Directive requires flood risk areas to be identified and Flood Risk Management Plans (FRMP) to be prepared at the appropriate river basin or sub-basin scale. These plans apply the principles of prevention, protection, and preparedness. Several flood risk management plans or sub-plans may be needed where local flood risks differ within the same river basin.

Flood risk management measures must be coordinated with the WFD. The Floods Directive explicitly requires that proposed flood protection measures take account of the environmental objectives set out in the RBMP. Where flood works alter morphology, continuity, flow regime, or habitats, they may affect ecological status or ecological potential. Such impacts must be assessed, avoided where possible and mitigated where necessary. If a flood protection project causes deterioration or prevents achievement of the relevant environmental objective, it must meet the conditions of WFD Article 4(7).

1.4.4 Drought Risk Management Plan

Water scarcity and drought are becoming more frequent and severe as water demand increases and climate change reduces the reliability of water resources. Long-term imbalance between demand and

available resources can affect public water supply, irrigation, hydropower, ecosystems, and environmental flows.

EU water policy promotes the prevention and mitigation of water scarcity and drought and encourages water-efficient and water-saving economies. It also emphasises that WFD implementation must give stronger attention to water quantity, because reduced flows and falling groundwater levels can directly affect ecological and chemical status.

In the absence of a dedicated EU directive for drought management, international good practice supports the preparation of Drought Risk Management Plans. These plans may be prepared at river basin, sub-basin, or municipal scale, depending on where drought impacts are most severe. For the Drin-Buna River Basin, these plans are not yet developed. They could support early warning, prioritisation of water uses, protection of environmental flows, drought-resilient irrigation management and coordinated action by competent authorities.

1.4.5 Coastal Zone Management Plan

The WFD requires the RBMP to include coastal water bodies and to assess their pressures, status, impacts, and environmental objectives in the same way as other water body categories. However, coastal zones also face management issues that extend beyond the core scope of the RBMP.

In the Drin-Buna River Basin, coastal management issues may include coastal erosion, sediment imbalance, infrastructure development, tourism pressure, coastal flooding, saline intrusion, and climate-change impacts. These pressures can affect coastal water status, transitional waters, wetlands, lagoons, and protected areas. The development of a Coastal Zone Management Plan (CZMP) is now in progress and should be coordinated with the RBMP and identify how coastal measures contribute to, or may affect, WFD environmental objectives.

In parallel, Albania is approximating the Marine Strategy Framework Directive (MSFD, 2008/56/EC), which extends environmental protection seaward from the coastal waters already covered under the WFD (2000/60/EC) to the wider marine environment. Under the EU4Rivers project, technical assessments led by the University of Salento and ARPA Puglia – covering descriptors such as biodiversity and eutrophication, non-indigenous species and marine litter - are generating data on pressures directly relevant to the Drin-Buna Basin's transitional and coastal waters, including excessive and unusual freshwater inputs and increased sedimentation rates, which are affecting coastal habitats and biodiversity. The resulting Marine Strategy should be coordinated with both the Coastal Zone Management Plan and the RBMP, ensuring consistent treatment of these shared pressures across the WFD and MSFD frameworks.

1.4.6 Strategic Environmental Assessment

Strategic Environmental Assessment (SEA) is an important instrument for integrating environmental considerations and sustainable development principles into strategic planning and decision-making. Because the Programme of Measures is a central output of the RBMP, and because measures may have regional or cross-sectoral environmental effects, the RBMP may require SEA review.

In Albania, Law No. 91/2013 on Strategic Environmental Assessment and its related by-laws provide the national legal framework for SEA. This framework is broadly aligned with Directive 2001/42/EC¹. The SEA process should assess the significant environmental effects of the RBMP and its Programme of Measures and should help ensure that proposed measures support, rather than undermine, the environmental objectives for surface water bodies, groundwater bodies, and protected areas.

¹ European Commission - Directive 2001/42/EC - On the assessment of the effects of certain plans and programmes on the environment, 'the strategic environmental assessment Directive'

2 Integrated Water Management at Basin Level

This chapter defines the strategic purpose and administrative foundation of the Drin-Buna River Basin Management Plan. It explains the objectives of the plan in line with the EU Water Framework Directive (WFD) and Albania's national water legislation. The section outlines the legal status and mandates of the competent authorities responsible for implementing the RBMP and describes how institutional coordination is organised between WRMA / AMBU, the River Basin Councils, and other relevant stakeholders. It also clarifies the structure of the RBMP documentation and how it aligns with the broader framework of integrated water resources management (IWRM) at basin and national levels.

2.1 EU Water Framework Directive (EU WFD)

2.1.1 Overview

The WFD sets out rules to halt deterioration of the status of surface water and groundwater bodies and achieve good status for Europe's rivers, lakes, and groundwater. Citizens, nature, and industry all need healthy rivers and lakes, groundwater, and bathing waters. The WFD focuses on ensuring good qualitative and quantitative health, i.e., on reducing and removing pollution and on ensuring that there is enough water to support ecosystems at the same time as human needs.

Since 2000, the WFD has been the main law for water protection in Europe. It applies to inland, transitional, and coastal surface waters as well as groundwater. It ensures an integrated approach to water management, respecting the integrity of whole ecosystems, including by regulating individual pollutants and setting corresponding regulatory standards. It is based on a river basin district approach to make sure that neighbouring countries cooperate to manage the rivers and other bodies of water they share.

As in Albania, many European river basins are international, crossing administrative and territorial borders. Therefore, a common understanding and approach is crucial to the successful and effective implementation of the Directive.

2.1.2 European Objectives & Laws

The key objectives of the WFD are set out in Article 4 of the Directive. It requires Member States to use their River Basin Management Plans (RBMPs) and Programmes of Measures (PoMs) to protect and, where necessary, restore water bodies to reach good status, and to prevent deterioration. Good status for surface water comprises good ecological status and good chemical status; ecological status is assessed using biological quality elements supported by physico-chemical and hydro morphological conditions. For groundwater, the objectives are good quantitative and good chemical status. The WFD is the primary legislation. It is supported by two so-called *daughter directives* on the quality and quantity of groundwater and on the quality of surface water.

The *Environmental Quality Standards Directive (2008/105/EC, amended by 2013/39/EU²)* focuses on the protection of surface water quality by setting environmental quality standards (EQS) for priority substances. The WFD also requires Member States to set and meet Environmental Quality Standards (EQS) for substances of national concern, i.e. river basin specific pollutants; the monitoring of which currently contributes to the assessment of ecological status. This list of priority substances needs to be reviewed and updated, if necessary, every 6 years. The directive is an essential instrument for safeguarding surface water quality under the WFD.

² Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy.

The *Groundwater Directive (2006/118/EC)*³ specifically targets the protection of groundwater against pollution and deterioration. It establishes criteria for assessing the chemical status of groundwater and requires Member States to define threshold values for key pollutants, such as nitrates and pesticides. Furthermore, it obliges Member States to develop and implement programs of measures aimed at preventing and limiting the input of contaminants into groundwater bodies. The directive is an essential instrument for safeguarding groundwater quality under the WFD. The list of pollutants and standards must also be reviewed every 6 years; these contribute to the assessment of chemical status in groundwater. The Directive also complements the WFD by including requirements as regards pollutant trends and quantitative status.

The WFD contains provisions regarding the deadlines for meeting the objectives of the Directive, as well as provisions on exemptions. The Annexes to the WFD specify details as regards, for example, monitoring requirements, the criteria for assessing water body status, and the contents of the RBMPs. The WFD is supported and integrates more targeted directives, i.e., the Water Directive⁴, the Bathing Water Directive⁵, the Nitrates Directive⁶, the Urban Wastewater Treatment Directive⁷, including the recent adjustments⁸ and finally the Floods Directive⁹.

2.1.3 WFD review 2019

Following that Fitness Check, the Commission planned a revision of Directive 2008/105/EC and Directive 2006/118/EC in 2022; the recast was formally adopted in April 2024 and will enter into force in 2026. Main conclusion was that the water legislation is broadly fit for purpose, with room for improvement related to investments, implementation, integrating water into other policies, chemical pollution, administrative simplification, and digitalization. The key findings show that the directives have led to a higher level of protection for water bodies and flood risk management than could have been expected without them. The objectives of the directives are as relevant now as they were at the time of the adoption, if not more.

This is certainly the case for Albania, which is in its initial phase of Integrated River Basin Management and Planning (RBMP). The methodology of the WFD offers good opportunities for an integral and efficient implementation of RBMPs. An advantage for Albania is that it can make use of previous experiences and lessons learned during the WFD implementation process in Europe.

2.1.4 Recent and forthcoming developments in EU water policy

The recent and forthcoming developments in EU water policy provide an important policy context for Albania's alignment with the EU water acquis and the implementation of the WFD.

The *European Water Resilience Strategy*, adopted by the European Commission in June 2025, places water resilience, restoration of the water cycle, water efficiency, and access to clean and affordable water at the centre of EU policy¹⁰. It promotes the 'Water Efficiency First' principle, sets a voluntary EU-wide target of 10% improvement in water efficiency by 2030 and links water resilience to investment, innovation, skills development, and ecosystem restoration.

In parallel, the *revised Urban Wastewater Treatment Directive*¹¹ introduces stricter requirements for wastewater collection and treatment, including obligations for smaller agglomerations above 1,000 population equivalent, advanced treatment for micropollutants at large treatment plants, improved management of stormwater and combined sewer overflows, energy neutrality of the wastewater sector

³ Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration.

⁴ Council Directive 75/440/EEC of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States.

⁵ Council Directive 76/160/EEC of 8 December 1975 concerning the quality of bathing water

⁶ European Parliament resolution on implementation of Directive 91/676/EEC on nitrates (2000/2110(INI)).

⁷ Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment

⁸ Decision (EU) 2022/591 of the European Parliament and of the Council of 6 April 2022 on a General Union Environment Action Programme to 2030.

⁹ Council Directive 2007/60/EEC concerning floods and flood mapping.

¹⁰ [https://ec.europa.eu/commission/presscorner/detail/en/ \"European Water Resilience Strategy - European Commission\"](https://ec.europa.eu/commission/presscorner/detail/en/\).

¹¹ European Commission (2024). *Revision of the Urban Wastewater Treatment Directive (recast)*.

and expanded monitoring of microplastics, antimicrobial resistance and emerging pollutants. It also aligns wastewater management with broader EU objectives on zero pollution¹², climate neutrality and circular economy.

Amendments to the WFD, the Environmental Quality Standards Directive and the Groundwater Directive¹³ further strengthen the EU framework for addressing chemical pollution in surface water and groundwater. They update the list of priority substances, introduce stricter environmental quality standards for several substances, strengthen the approach to persistent and mobile contaminants such as PFAS, selected pharmaceuticals and pesticides, and improve monitoring and data collection through watch-list mechanisms.

In addition, the announced broader review of the WFD in 2026 may clarify the application of EU environmental legislation in permitting procedures, including for strategic investments such as mining and other industrial activities, while maintaining the core objectives of protecting aquatic ecosystems and human health. This initiative was announced in the context of the *RESourceEU Action Plan*¹⁴, which forms part of the EU strategy to strengthen the Union's economic resilience and secure access to critical raw materials.

For Albania, these developments are highly relevant. They confirm that future WFD implementation will require stronger integration between river basin planning, pollution control, wastewater investment, monitoring, data management, and economic development. Alignment with the revised wastewater legislation will be a major implementation challenge, given the current limitations in sewerage coverage, wastewater treatment capacity, monitoring systems and institutional resources, but it also offers a clear opportunity to modernise infrastructure, improve water quality in rivers and coastal areas, and support tourism, public health and sustainable urban development.

The strengthened chemical water legislation will require Albania to progressively expand monitoring networks, laboratory capacity, analytical scope, and data management, especially for emerging pollutants such as PFAS, pharmaceuticals, pesticides, microplastics and antimicrobial resistance. This will be essential for robust chemical status assessments, targeted Programmes of Measures and credible River Basin Management Plans. The Water Resilience Strategy also reinforces the need to address water scarcity, efficiency, climate resilience, and ecosystem restoration as integral parts of basin planning. For Albania's WFD implementation trajectory, the combined impact is that river basin management plans cannot be limited to formal compliance documents. They should increasingly function as strategic investment and coordination frameworks, linking environmental objectives, infrastructure priorities, monitoring development, institutional capacity building, and EU accession requirements. Gradual alignment with these EU policy and legislative developments will therefore be important for achieving good status of water bodies, prioritising measures, mobilising finance and strengthening Albania's credibility in the EU accession process.

2.1.5 River Basin Management Plans (RBMPs)

The River Basin Management Plans (RBMPs) are the key tools for implementing the WFD. They are drawn up after stakeholder and public consultation and produced on a six-year planning cycle. These plans provide a comprehensive approach to water management, incorporating various aspects such as water quality, quantity, ecological status, prevention of pollution, and economic aspects. RBMPs aim to achieve and maintain good water status in all water bodies, including rivers, lakes, groundwater, and coastal areas. RBMPs serve as the practical implementation of the WFD at the river basin level, ensuring coordinated and integrated management of water resources to achieve sustainable water outcomes.

¹² European Commission. *Zero Pollution Action Plan for Water, Air and Soil*.

¹³ European Commission (2022). Proposal for a Directive amending the Water Framework Directive, the Groundwater Directive and the Environmental Quality Standards Directive.

¹⁴ European Commission (2025). *RESourceEU Action Plan for securing critical raw materials and strengthening EU economic resilience*.

2.1.6 Common Implementation Strategy (CIS), Working Groups and Guidance Documents

The implementation of the WFD raises several shared technical challenges for the Member States, the Commission, the Candidate and EEA Countries as well as stakeholders and NGOs. To address these challenges in a co-operative and coordinated manner, the Commission agreed on a Common Implementation Strategy (CIS) for the WFD only five months after the directive came into force. The CIS aims to ensure the coherent and harmonious implementation of the WFD and its daughter directives. Within this framework, several technical Working Groups operate, for example by producing Guidance Documents on technical aspects, key events, and additional thematic documents¹⁵.

For the development of the Drin-Buna RBM plan and its Task Reports, the following CIS Guidance Documents were used:

- Guidance No 01 - Economics - WATECO (WG 2.6)
- Guidance No 02 - Identification of water bodies
- Guidance No 03 - Pressures and impacts - IMPRESS (WG 2.1)
- Guidance No 04 - Heavily modified water bodies - HMWB (WG 2.2)
- Guidance No 07 - Monitoring (WG 2.7)
- Guidance No 09 - GIS (WG 3.1)
- Guidance No 10 - Reference conditions inland waters - REFCOND (WG 2.3)
- Guidance No 13 - Classification of Ecological Status (WG A)
- Guidance No 15 - Groundwater Monitoring Guidance Nov-2006_FINAL-2
- Guidance No 16 - Groundwater in DWPA's
- Guidance No 18 - Groundwater Status-Trend assessment
- Guidance No 19 - Surface water chemical monitoring
- Guidance No 26 - GW risk assessment and conceptual models
- Guidance No 27 - Deriving Environmental Quality Standards - version 2018-1
- Guidance No 34 - Climate change & adaptation
- Guidance No 37 – Derogations & Exemptions.
- WFD Reporting Guidance 2016 and the subsequent WFD Reporting Guidance 2022 for reporting the 3rd River Basin Management Plans

2.2 Integrated Water Resources Management in Albania

2.2.1 Introduction

Water is fundamental for life. Clean and sufficient water in ponds, lakes, reservoirs, and rivers is part of the quality of the living environment and an important condition for economic progress. Good quality and quantity of groundwater and surface water are important for agriculture, the cost-effective preparation of drinking water and process water for the industry. Good water quality in villages and towns ensures a pleasant quality of life; it is good for health and is a condition for recreational use. Finally, good water quality is essential for a healthy water environment. In short, clean, and sufficient groundwater and surface water are essential for economic and social interests. Briefly, this is the essence of Integrated Water Resources Management (IWRM).

As a natural resource, water is an essential part of society that contributes significantly to sustain socio-economies, livelihoods, water security, and ecosystem services. Hence, water resources are in demand by multiple stakeholders including water users from various sectors. The protection, improvement and management of water quantity and quality of all waters in river basins including the ecosystems that depend on these are essential to ensure long-term, sustainable use of water resources as well as to prevent further deterioration. The achievement of these aims can be ensured by River Basin Planning and Management (RBM), which should be supported by legal frameworks (in force through the National Strategy of Water Resources Integrated Management 2018-2027¹⁶), implementation of structural and non-structural measures and monitoring and control. In addition, implementation of IWRM through river

¹⁵ Library on Guidance Documents

¹⁶ The National Strategy of Water Resources Integrated Management 2018-2027 was approved by Regulation No. 73 dated 7 February 2018.

basin planning and management supports global frameworks and commitments like the achievement of the UN Sustainable Development Goals (SDG's)¹⁷ and the resilience of water resources in relation to climate change.

2.2.2 General topographical and geographical characteristics of river basins in Albania¹⁸

Albania has abundant water resources, divided into seven river basins (Drin-Buna, Vjosa, Drin-Buna, Shkumbin, Mati, Ishëm, Erzen), of which two are transboundary: Drin-Buna is shared with Greece, Montenegro, Republic of North Macedonia, and Kosovo; Vjosa is shared with Greece. Albania is also home of three major natural lakes (Ohrid, Prespa and Skadar), 247 small natural lakes, and 650 artificial reservoirs. The country has access to the Adriatic and Ionian Seas with a coastline of 427 km, of which 273 km on the Adriatic Sea and 154 km on the Ionian Sea. The coast also hosts several major protected lagoons: Kune-Vain in the North, Karavasta and Narta, and Butrint in the South.

Groundwater resources are abundant, between 9 billion m³/year and 13 billion m³/year. Albania has approximately 9,000 –10,000 m³ per capita per year (EEA, 2023), placing Albania among the ten most water-abundant countries in Europe. However, the available quantity of surface water (and to a lesser extent, of groundwater) drastically decreases during the summer dry season (July-September), with only 6-9% of annual runoff.

Albania's diverse topography, characterized by rugged mountains, expansive valleys, and a narrow coastal plain, significantly influences the formation and behaviour of its river basins. The country's hydrographic network comprises numerous rivers that primarily drain into the Adriatic and Ionian Seas, with a minor portion flowing toward the Black Sea.

2.2.3 Overview of the Drin-Buna River Basin

The Drin–Buna River Basin is located in north-western Albania, between approximately 40.78°N and 42.50°N latitude and 19.41°E and 20.90°E longitude. The total catchment area is approximately 14,173 km², of which about 5,870 km² lies within Albanian territory; the remainder is shared among Kosovo, North Macedonia, Greece and Montenegro. The basin extends from the Adriatic coastal lowlands near sea level to alpine headwaters exceeding 2,500 m a.s.l. in the Albanian Alps, creating an exceptionally strong topographic gradient over a relatively short horizontal distance. The mean basin elevation is approximately 971 m a.s.l.

The climate of the basin is fundamentally Mediterranean in character, yet profoundly modified by elevation, relief, and valley structure. Maritime air masses from the Adriatic dominate the lower elevations, producing mild winters and abundant rainfall, while orographic lifting over progressively higher terrain enhances precipitation and reduces air temperatures, increasing the proportion of snowfall and the duration of snow cover. Within the Albanian climatic regionalisation, the basin intersects several zones: the Mediterranean Lowland, Mediterranean Hilly, Mediterranean Pre-mountain, and Mediterranean Mountain climate zones, each with distinct temperature and precipitation characteristics.

This vertical zonation results in pronounced spatial gradients in all hydro-meteorological variables. Mean annual precipitation across the 57 meteorological stations used in this study ranges from approximately 763 mm in drier, more sheltered interior valleys to over 2,521 mm in the most exposed mountain sectors, with a basin-average of roughly 1,464 mm. Temperature, evapotranspiration, and drought conditions vary correspondingly with altitude and exposure.

The Drin River, the largest river in Albania, is formed by the confluence of two major tributaries: the Drin i Zi (Black Drin), originating from Lake Ohrid in North Macedonia, and the Drin i Bardhë (White Drin), rising in Kosovo. After their confluence near Kukës, the combined Drin flows through three major hydropower dams, the Fierza–Koman–Vau i Dejës cascade (combined installed capacity 1,350 MW,

¹⁷ UN Sustainable Development Goals (SDG's)

¹⁸ Several sources: (i) AP News. (2023, March 15). Albania declares Vjosa River a national park in Europe-first; (ii) INWEB – International Network of Water-Environment Centres for the Balkans. (n.d.). Drin River Sub-Basin; (iii) Wikipedia contributors. (2023, November 17). List of rivers of Albania; (iv) European Commission & Albanian Ministry of Tourism and Environment. (2021). River Basin Management Plan for the Drin-Buna and Drin-Buna Basins 2020–2026; Annex I, Description of Action: EU for Water - Component 1: EU4Rivers, 2024.

producing approximately 90% of Albania's hydropower), before reaching the Adriatic lowlands. The Buna River, the outlet of Lake Shkodër, receives the Drin's discharge approximately 1.5 km downstream of the lake and flows 41 km to the Adriatic. The mean annual discharge at the basin outlet (Bahçallëk) is approximately 350 m³/s, corresponding to a runoff depth of approximately 779 mm/yr and a runoff coefficient of 0.65. Major alpine tributaries, the Valbona, Shala, and Kiri, contribute high specific discharges (up to 65 l/s·km²) from the precipitation-rich Albanian Alps.

2.3 Development of the Drin-Buna RBMP

2.3.1 River Basin Management Cycle

The methodology will involve harmonizing the RBM approach across the river basin, based on the existing RBMP framework developed for other basins, fully by the requirements of WFD and Law on Water Resources 29/2024, as amended and the DCM 1015¹⁹. This approach is consistent with the RBM cycle outlined in the WFD.

The River Basin Management (RBM) Cycle provides a structured framework for the planning and management of entire river basins, extending beyond administrative boundaries to cover the full hydrological drainage area. The product of each RBM Cycle is a River Basin Management Plan (RBMP), developed collaboratively by responsible water authorities and key stakeholders.

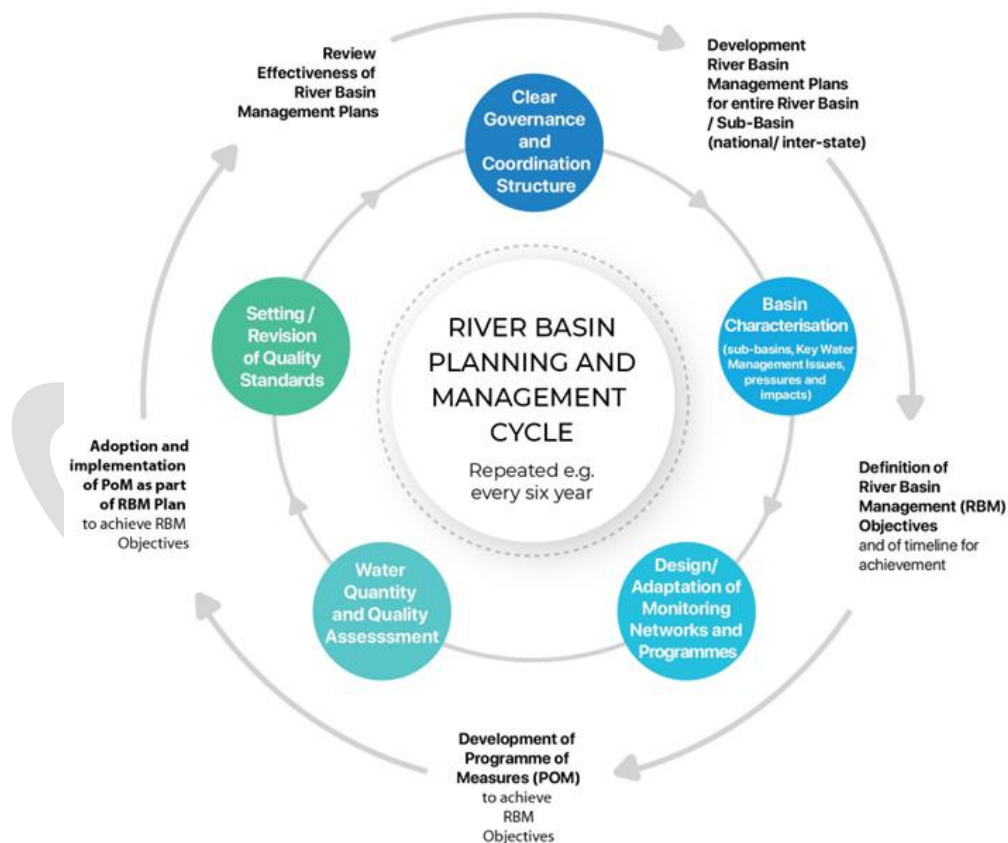


Figure 2 - The River Basin Management Cycle based on the implementation requirements of the WFD.

¹⁹ Decision of the Council of Ministers No. 1015, dated 16.12.2020, "On the content, development and implementation of the National Water Resources Management Strategy, River Basin Management Plans and Flood Risk Management Plans".

Each RBMP is specific to an individual river basin and follows a systematic planning process that includes:

1. *Setting Environmental Objectives*: establishing environmental goals for all groundwater and surface waters within the river basin.
2. *Identifying Significant Water Management Issues (SWMIs)*: recognizing the critical challenges and issues within the basin that need to be addressed.
3. *Conducting Pressure/Impact Analyses*: performing qualitative and quantitative assessments of the basin's status and risks, focusing on pressures and impacts affecting water quality and availability.
4. *Proposing a Programme of Measures (PoM)*: developing a set of concrete actions designed to improve the condition of the basin's water bodies, aligned with the agreed-upon environmental objectives. The PoM is the central component of any RBMP, outlining the steps necessary to achieve the desired outcomes.

In addition to addressing water management issues, the implementation of the WFD requires the integration of other environmental priorities, economic considerations, and social concerns when setting water management objectives.

2.3.2 Methodology and approach for preparing the River Basin Management Plan

The DPSIR (Drivers, Pressures, State, Impact, and Response) model is the theoretical framework used to develop RBMPs. This methodology describes the interactions between society and the environment, guiding the identification of key factors (drivers and pressures) that influence the state of water bodies, the impacts of these factors, and the appropriate responses needed to address them effectively.

This approach ensures a comprehensive understanding of the river basin's dynamics, enabling the development of robust and effective management plans that promote sustainable water resource management across the entire basin.

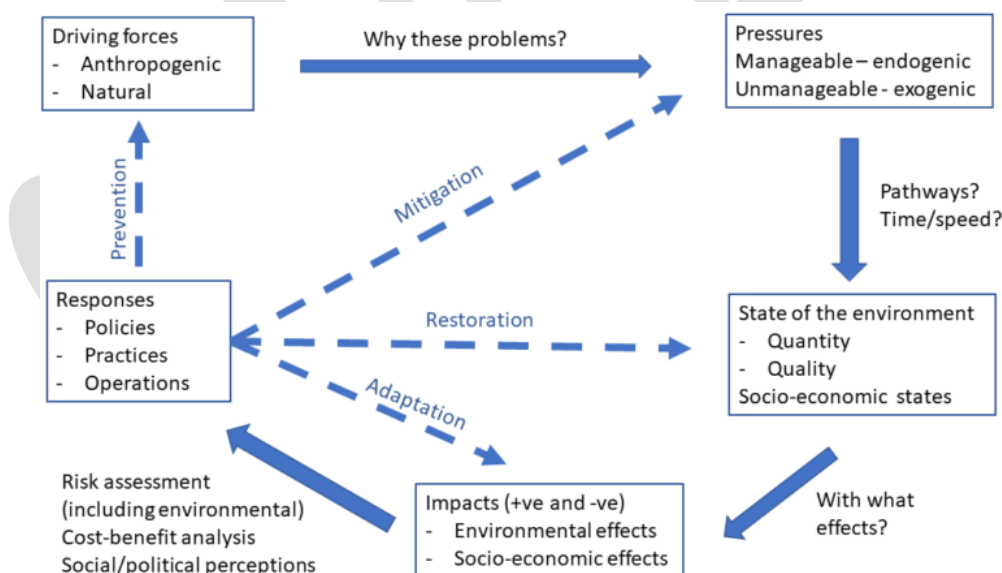


Figure 3 - The DPSIR framework (source: Guidance Document No. 3).

The RBMP development process follows the DPSIR model, which is used to understand the interactions between societal activities and environmental conditions. The framework includes:

- ◆ *Driving Forces*: social, demographic, and economic developments that influence human activities impacting the environment.
- ◆ *Pressures*: the direct consequences of these driving forces on the environment.
- ◆ *State*: the current physical, chemical, and biological conditions of the environment.

- ◆ **Impact:** the effects of changes in the environmental state, leading to environmental degradation.
- ◆ **Responses:** actions taken to mitigate issues identified in the earlier stages, aiming to reduce pressures, restore environmental conditions, and address impacts.

The following steps and main activities were conducted, partly in parallel, based on the WFD requirements for developing the RBMP (reference is made to the most important WFD Articles and Annexes):

1. Mutual understanding on the purpose, definitions, and steps of the RBM Cycle based on WFD approach (WFD, Article 1 and 2);
2. Setting up of the institutional framework to develop and implement the RBMP by the dedicated competent authorities at National level and at basin level by the RBCs with all responsible water authorities and relevant stakeholders (WFD, Article 3);
3. Prepare a basic outline of the RBM plan (WFD, Article 13 and Annex VII);
4. **Drivers & Pressures:** Identification of Significant Water Management Issues (SWMIs) and definition of vision and management objectives for each SWMI (WFD, Article 5 and Annex II);
5. Delineation of Surface Water Bodies, Groundwater bodies, and Protected areas (WFD, Article 5, Annex II, and Annex IV for protected areas);
6. Environmental Objectives, Environmental Quality Standards and Establishment of Provisional Reference Conditions for both surface- and groundwater bodies (WFD, Article 4 (objectives); Article 16 (EQS) and Annex V (classification & reference conditions);
7. **State & Impact:** Groundwater and Surface water monitoring analysis (WFD, Article 8 and Annex V) and the qualitative and quantitative pressure & risk analysis and status assessment (WFD, Article 5 and Annex II, V);
8. **Response:** Development of the Programme of Measures (PoM, WFD, Article 11 and Annex VI) and the RBM Plan (WFD, Article 13 and Annex VII);
9. Methodological analysis on developing Groundwater and Surface water monitoring programs and analysis following the EU guidance (WFD, Article 8 and Annex V);
10. Economic Analysis of Water Uses, Revenue Analysis and Cost Recovery (WFD, Article 9 and Annex III).

All above steps and activities are described in detail in several Technical Task Reports attached as Annexes to the RBMP.

Table 1 - Overview of all technical Task Reports prepared for the RBMP.

Task Report	Name	Main activities
1	Delineation of water bodies	5
2	Register of Protected Areas	4, 5
3	RBMP Objectives & Overview of SWMIs	4
4	Monitoring Network, data collection & data analysis of existing conditions	7, 9
5	Environmental objectives, EQS, and establishment of provisional reference conditions	6
6	Drivers & Pressures Analysis	7
7	Program of Measures (PoM)	8
8	Initial Economic Analysis of Water Uses, Revenue Analysis and Cost Recovery	10
9	Hydrological Analysis (water Balance surface & groundwater)	4, 5, 7
10	Reports of the technical workshops for developing the RBM plan and the PoM	2, 3, 7
11	Atlas of Maps of the Basin	-
12	Inventory of relevant River Basin Management Data	4, 5, 7 & 10

2.3.3 Implementation timeline of the Drin-Buna RBM Plan

The RBM process is based on multi-year planning and implementation cycles that are to be repeated at a certain frequency to enable a revision process, adjustment to new conditions in the basin, and addressing new challenges. The RBM Plan cycle is planned to be repeated every 6 years with an updated pressure/impact analyses and risk assessments in between to estimate improvements and the achievement of the overall aims and objectives of the River Basin.

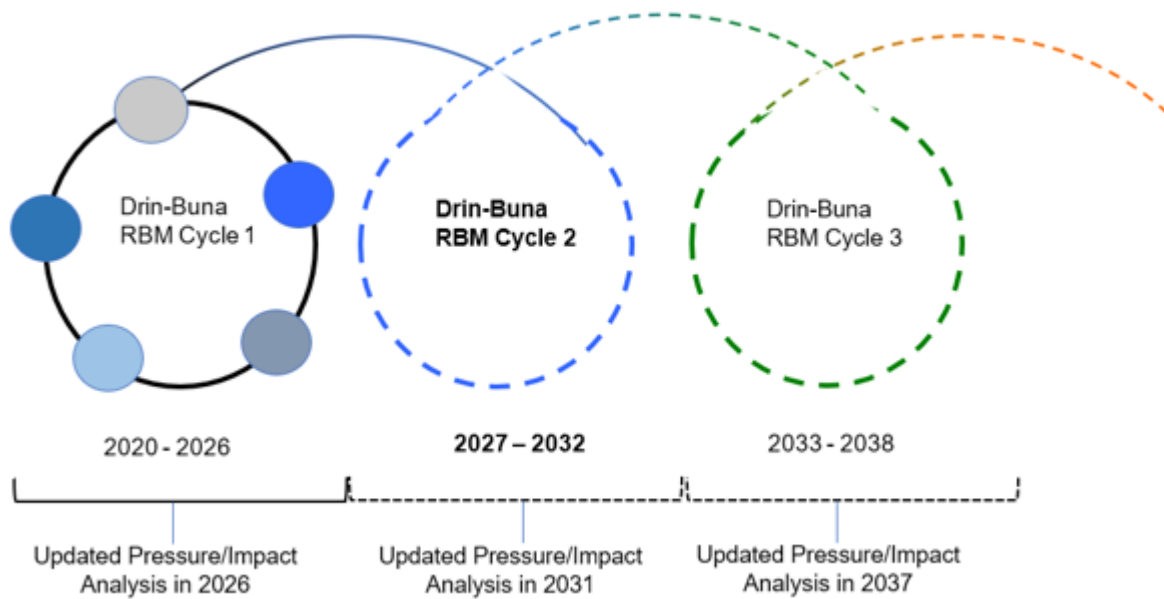


Figure 4 - Timeline and review frequencies for the Drin-Buna RBM Plan.

In the above context, the 2nd Drin-Buna RBM Plan, developed within the RBM Cycle (see Figure 4) will last from 2027 - 2032. It will be followed by consecutive cycles to achieve the overall Drin-Buna river basin aims and objectives. The initial work towards the first Drin-Buna RBM Plan started in 2019, with approval of the first RBM plan in 2020 by the Council of Ministers and with an implementation period until end of 2026.

2.4 Changes and updates of the first RBMP of the Drin-Buna River Basin

3 Stakeholder Involvement and Public Consultation

This chapter presents participatory mechanisms guiding stakeholder involvement in RBMP development. It describes how the principles of transparency, inclusiveness, and public participation, central to the WFD, are applied in the Drin-Buna River Basin. The section summarises the main consultation activities conducted during plan preparation, including basin-level workshops, institutional meetings, and public disclosure processes. It highlights how feedback from stakeholders has been integrated into the plan to ensure legitimacy, ownership, and practical implementation.

Additional background, technical information, and summary of the presentations are presented in the Task Reports 3 and 10.

3.1 Public Consultation and Stakeholder Engagement

The preparation of the Drin-Buna River Basin Management Plan was supported by a continuous process of consultation and cooperation with competent institutions, local authorities, water users, civil society organisations, academia, experts, and other relevant stakeholders. The consultation process aimed to ensure a participatory and transparent approach to river basin management planning, in accordance with the requirements of the EU WFD and the Albanian legal framework.

Stakeholder engagement was considered an essential component of the planning process, providing opportunities for interested parties to contribute their knowledge, experience, and perspectives throughout the development of the River Basin Management Plan. Through technical workshops, field visits, institutional meetings, public consultations, and the work of the Interinstitutional Working Group, stakeholders actively contributed to the identification of Significant Water Management Issues, the assessment of pressures and impacts, the development of environmental objectives, and the formulation of the Programme of Measures.

The consultation process aimed to ensure transparency, stakeholder engagement and coordination, and the integration of local knowledge into the planning process, thereby contributing to the development of a River Basin Management Plan that reflects the actual needs and challenges of the basin. This approach is in line with *Article 14* of the EU WFD, which requires the active involvement of stakeholders and public consultation during the preparation of River Basin Management Plans.

Furthermore, Law No. 146/2014 supported the process “*On Public Notification and Consultation*”, which establishes the rules and procedures for the consultation of strategic documents and public policies in the Republic of Albania.

3.1.1 Significant Water Management Issues and Institutional Assessment

In January 2025, a technical meeting was organised in Shkodër with the participation of representatives from national and local institutions, the Drin-Buna River Basin Administration Office (RBAO), non-governmental organisations, and other relevant stakeholders. The event focused on the preliminary identification of Significant Water Management Issues, as well as on the institutional assessment of the capacities and responsibilities of the institutions involved in water resources management.

The discussions highlighted the main pressures affecting the status of water bodies within the basin, the institutional challenges related to the implementation of the EU WFD, and the need to strengthen interinstitutional coordination throughout the preparation and implementation of the River Basin Management Plan.



Figure 5 - Representatives from national and local institutions on a technical meeting in Shkodër (January, 2025).

3.1.2 Technical Workshop on the Identification of SWMIs and Field Visits

On 19–20 February 2025, a technical workshop entitled “*Vision, Objectives and Goals for the Significant Water Management Issues in the Drin-Buna River Basin*” was held in Shkodër within the framework of the EU4Rivers Project. The event brought together representatives from the National Water Agency (AMBU), the Drin-Buna Administration Office, local authorities, non-governmental organisations, and national and international experts. During the workshop, the preliminary results of the pressure, impact, and risk assessment were presented, followed by discussions on the long-term vision and management objectives for addressing the identified SWMIs within the basin.



Figure 6 - Workshop Drin-Buna River Basin, Shkodër, February 19, 2025.

As part of the event, several field visits were organized to locations of specific importance for water management in the basin, including Lake Shkodra, the Wastewater Treatment Plant, and the Kiri water body near Shkodër. These visits provided an opportunity to discuss key issues related to water quality, urban wastewater discharges, and solid waste disposal, while also allowing participants to better understand the local challenges affecting the ecological and chemical status of water bodies in the basin.



Figure 7 - Kiri River near Shkodër.



Figure 8 - WWTP on Lake Shkodër.

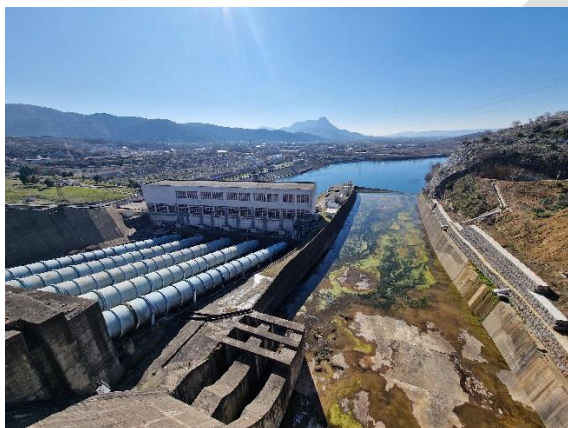


Figure 9 - Vau i Dejës Dam and Hydroelectric Power Station on the Drin River.

The field visit confirmed that the upper Kiri River remains largely pristine, while the section near Shkodër is heavily affected by untreated wastewater and solid waste from urban and industrial sources. At Lake Shkodër, a secondary wastewater treatment plant operating since approximately 2022 has improved effluent quality, although the reuse of contaminated sewage sludge remains a concern.

The Vau i Dejës Hydropower Plant, the third facility in the Drin cascade, has an installed capacity of 260 MW and underwent infrastructure rehabilitation in 2024. An adjacent 12.9 MW solar PV installation supplies renewable energy to support the facility's operations. Dam management currently lacks an environmental flow regime, with downstream flows determined solely by turbine releases.

3.1.3 Technical Visit to the Bulqiza

In May 2025, as part of the preparation process of the Drin-Buna River Basin Management Plan, a technical field visit was conducted in Bulqiza with the participation of representatives from the WRMA, the Drin-Buna RBAO, local authorities, and experts from the EU4Rivers Project. The visit focused on assessing chemical pressures associated with mining activities and their potential impacts on the water bodies within the basin.

During the visit, participants inspected mining areas and mineral processing facilities, discussing the potential environmental risks associated with mining operations. Mining activities can exert significant

pressure on both surface water and groundwater due to the potential release of heavy metals, the transport of contaminated sediments, and acid mine drainage from mining waste and tailings. These processes may adversely affect water quality and aquatic ecosystems, posing risks to the achievement of the environmental objectives established under the WFD.

The discussions with institutional representatives and local operators focused on environmental monitoring practices, mining waste management, compliance with environmental permit requirements, and the need for continuous monitoring and control of potential impacts on water resources. The visit provided valuable insight into the specific pressures generated by the mining sector. It supported the identification of potential measures to be incorporated into the Programme of Measures of the Drin-Buna River Basin Management Plan.



Figure 10 - Chrome mining factory in Bulqize, in operation since 1972.



Figure 11 - Gravity separation is often applied, as chromite has a higher specific gravity than surrounding waste material.



Figure 12 - Primary crushing and beneficiation.



Figure 13 - The resulting concentrate is stockpiled in openair storage reservoirs and shipped to smelters for further processing.



Figure 14 - Extraction through open-pit mining.

3.1.4 Workshop on the Programme of Measures and Status Assessment

On 1 April 2026, a technical workshop on the *Programme of Measures (PoM)* and *Status Assessment* of the Drin-Buna River Basin water bodies was organised in Shkodër. The event brought together representatives from the WRMA, the Drin-Buna RBAO, local authorities, and experts from the EU4Rivers, as well as other relevant stakeholders.

The workshop focused on strengthening the link between the identified pressures, their impacts on water bodies, and the concrete measures required to achieve the environmental objectives of the EU WFD. Through interactive group discussions, participants assessed the main anthropogenic pressures affecting both surface water and groundwater bodies, evaluated their impacts on water status, and identified priority basic and supplementary measures for inclusion in the next River Basin Management planning cycle.

Particular attention was given to the DPSIR approach (Drivers–Pressures–State–Impacts–Responses), enabling participants to systematically analyse the relationships between human activities, environmental pressures, water status, and the responses needed to improve and protect water resources. The workshop also provided a platform for institutional representatives and experts to exchange knowledge, identify implementation gaps, and discuss realistic and feasible measures tailored to the specific conditions of the Drin-Buna River Basin.



Figure 15 - Interactive working sessions for the Drin-Buna River Basin in Shkodër, 1 April 2026.



Figure 16 - Technical workshop on the Programme of Measures (PoM) and Status Assessment of the Drin-Buna River Basin water bodies, in Shkodër, 1 April 2026.

The activity was complemented by a field visit in the Dibër region, including visits to hydropower facilities and aquaculture sites. The field observations allowed participants to directly examine issues related to flow regulation, hydromorphological alterations, water abstraction, and aquaculture practices, thereby linking the technical discussions with actual challenges and management needs observed within the basin.

Inside the HEC Seta 4, with 4 turbines with an installed capacity of 4.724 MW. The theoretical maximum production is approximately 41.4 GWh per year. A more realistic annual production is often in the range of 12–25 GWh per year, depending on local hydrology and operational management.



Figure 17 Inside the HEC Seta 4 in the Dibër region.



Figure 18 - Fish farming in the downstream part of the Seta River valley.



Figure 19 - Huge landfill with municipal solid waste.

The observed landfill is far too small and solid waste and drainage of contaminated water pollutes the groundwater and small stream directly flowing into the Drin River.

3.1.5 Interinstitutional Working Group for the River Basin Management Plan

To ensure effective coordination and active participation of the responsible institutions, the Prime Minister's Order establishing and governing the Interinstitutional Working Group for the preparation of River Basin Management Plans was approved in November 2024.

Under this Order, representatives of the key institutions responsible for water management, environmental protection, agriculture, energy, local government, and other sectors related to the use and protection of water resources were nominated to participate in the Interinstitutional Working Group and contribute to the development of the River Basin Management Plans.

The role of the Interinstitutional Working Group includes:

- providing sectoral data and information required for the preparation of the River Basin Management Plans;
- reviewing and commenting on technical documents prepared throughout the planning process;
- ensuring interinstitutional coordination in addressing Significant Water Management Issues and other water management challenges;
- supporting the public consultation and stakeholder engagement process;
- contributing to the identification, assessment, and prioritisation of measures to be included in the Programme of Measures (PoM);
- facilitating communication and cooperation among the relevant institutions involved in water resources management;
- supporting the implementation of the River Basin Management Plans following their approval and adoption.

The Interinstitutional Working Group served as an important coordination platform throughout the RBMP preparation process, ensuring that sectoral priorities, institutional expertise, and stakeholder perspectives were adequately reflected in the planning and decision-making process. *To date, four dedicated meetings of the Interinstitutional Working Group have been organised as part of the preparation of the River Basin Management Plans. These meetings provided a structured platform to review technical progress, discuss key challenges, validate draft outputs, strengthen interinstitutional coordination, and provide strategic guidance throughout the RBMP development process.*



Figure 20 - Interinstitutional Working Group meeting in Tirana, 2026.

3.2 Stages of the Public Consultation of the Drin-Buna RBMP

In accordance with the requirements of Article 14 of the EU WFD (2000/60/EC) and the national legislation on public consultation, the consultation process for the Drin-Buna River Basin Management Plan (RBMP) was conducted in several phases.

The first phase of public consultation commenced on 25 April 2025 with the publication of the document on Significant Water Management Issues (SWMIs). The document was made available to public institutions, local authorities, civil society organisations, water users, and the public for a six-month consultation period, to collect comments and recommendations on the key water management challenges identified within the basin and on the proposed management priorities.

The second phase of public consultation commenced on with the publication of the Draft Drin-Buna River Basin Management Plan. The draft plan remained open for public consultation for a period of six months, providing all interested stakeholders and the public with the opportunity to submit comments, suggestions, and recommendations on the proposed planning framework and measures. During this period, several information and consultation activities were organised involving responsible institutions, local authorities, the business community, environmental organisations, water users, and other stakeholder groups. All comments and recommendations received during the consultation process were reviewed and assessed as part of the finalisation of the River Basin Management Plan, with consideration given to issues of social, economic, and environmental importance within the Drin-Buna River Basin.

The consultation process aimed to ensure transparency, active public participation, and broad stakeholder involvement in decision-making, thereby ensuring that the River Basin Management Plan reflected the needs of the basin and supported the sustainable protection, management, and use of water resources.

4 DRIN-BUNA RIVER BASIN OVERVIEW

This chapter provides the characteristics of the Drin-Buna River Basin and establishes the baseline for river basin management planning. It describes the basin's geographical extent, major sub-basins, and transboundary character, with emphasis on cooperation between Albania, Montenegro, North Macedonia, Kosovo and Greece in line with Articles 3 and 13 WFD. It summarises the basin's physical, ecological, and socio-economic characteristics, including topography, land use, demography, economic activities, geology, soils, hydro morphology, biodiversity, and protected areas.

Additional background, technical information and data are presented in the Task Reports 1, 2, 8, 9 and 12.

4.1 Introduction of the Drin-Buna River Basin

4.1.1 Geographical extent

The Drin-Buna River Basin forms Albania's largest and most water-rich river basin system and is part of the wider transboundary Drin Basin in the south-eastern Balkans. The Drin–Buna River Basin is located in north-western Albania, between approximately 40.78°N and 42.50°N latitude and 19.41°E and 20.90°E longitude. The total catchment area is approximately 14,173 km², of which about 5,870 km² lies within Albanian territory; the remainder is shared among Kosovo, North Macedonia, Montenegro and Greece. The basin extends from the Adriatic coastal lowlands near sea level to alpine headwaters exceeding 2,500 m a.s.l. in the Albanian Alps, creating an exceptionally strong topographic gradient over a relatively short horizontal distance.

Major lakes

Within the basin there are three major lakes:

- Lake Shkoder is the largest, varying from 370 km² to 530 km². The lake is shallow with an average depth of 5 metres, and its elevation varies from 4.7 to 9.8 metres above sea level. Its volume is 1.93×10⁹ m³. The lake is fed partly by the inflow of the surrounding rivers and partly by karstic springs, which rise within the lake itself.
- Lake Ohrid is one of Europe's deepest and oldest lakes, preserving a unique aquatic ecosystem that is of worldwide importance, with more than 200 endemic species. It has a surface area of 388 km² and an average depth of 155m and a maximum depth of around 300 metres. Its surface is at an elevation of 693 metres. Its volume is 55.49×10⁹ m³.
- Lake Prespa lies within an endorheic basin, i.e. with no river flowing out of it. It includes two lakes: The Great Prespa Lake and the Small Prespa Lake. Its total surface area is 274 km² and its volume is 4.8×10⁹ m³. With a surface elevation of 854 m, it is the highest lake in the Balkans. The average inflow to Lake Prespa has been estimate as 2.55 m³/s. It is likely that all of this is transferred underground to Lake Ohrid. Given the large difference in surface elevation between Lake Prespa and Lake Ohrid, the variation in lake level is relatively small and the flow rate will not vary much throughout the year.

Major sub-basins

The Drin River in the Albanian territory is characterized by a mountainous relief, with average altitude of 971 metres above sea level, with approximately 50% of the catchment area of the river in the territory of Albania situated at an altitude 850 m. The Drin River, which starts from Ohrid Lake in Struga and ultimately discharges into the River Buna, has a length of 285 km and a drop of 685 metres, corresponding to an average gradient of 2.3%. The Drini River is formed from two main branches: the Black and White Drin. The length of the Black Drin River, from Lake Ohrid to Kukës, is 149km and the surface of the basin is 5,885 km², while the White Drin from the source (Kosovo) to the confluence with the Black Drin River has length of 136 km and basin surface of 4,964 km².

After their confluence near Kukës, the combined Drin flows through three major hydropower dams, the Fierza–Koman–Vau i Dejës cascade (combined installed capacity 1,350 MW, producing approximately

90% of Albania's hydropower), before reaching the Adriatic lowlands. Until 1956 (when the implementation of Vau i Dejës Hydropower started), the Drin River after Vau Deja was divided into two branches, i.e. Bahçallëk, which discharged in Boone and the branch of Lezha, which after receiving the Gjadrit waters discharged to the sea close to the city of Lezha. With the construction of the Gjadri and Mjed embankment, the waters of the Drini River go mainly towards Bahçallëk, joining the river flow of Buna.

The Buna River originates from Lake Shkoder. The surface of the Buna River watershed is 5,179 km², of which 1,025 km² is contained within national territory of Albania, while the rest situated in Montenegro. The Buna River, from starting point in Samerisht village until his discharge in the Adriatic Sea has a length of 24 km, separating the state border between Albania and Montenegro. The average altitude of the Buna River is 909 m above sea level. The Buna River collects the waters of Drin River and water from Shkoder Lake. The Buna River features a classic delta, consisting of several alluvial islands, located in the estuary of the river.

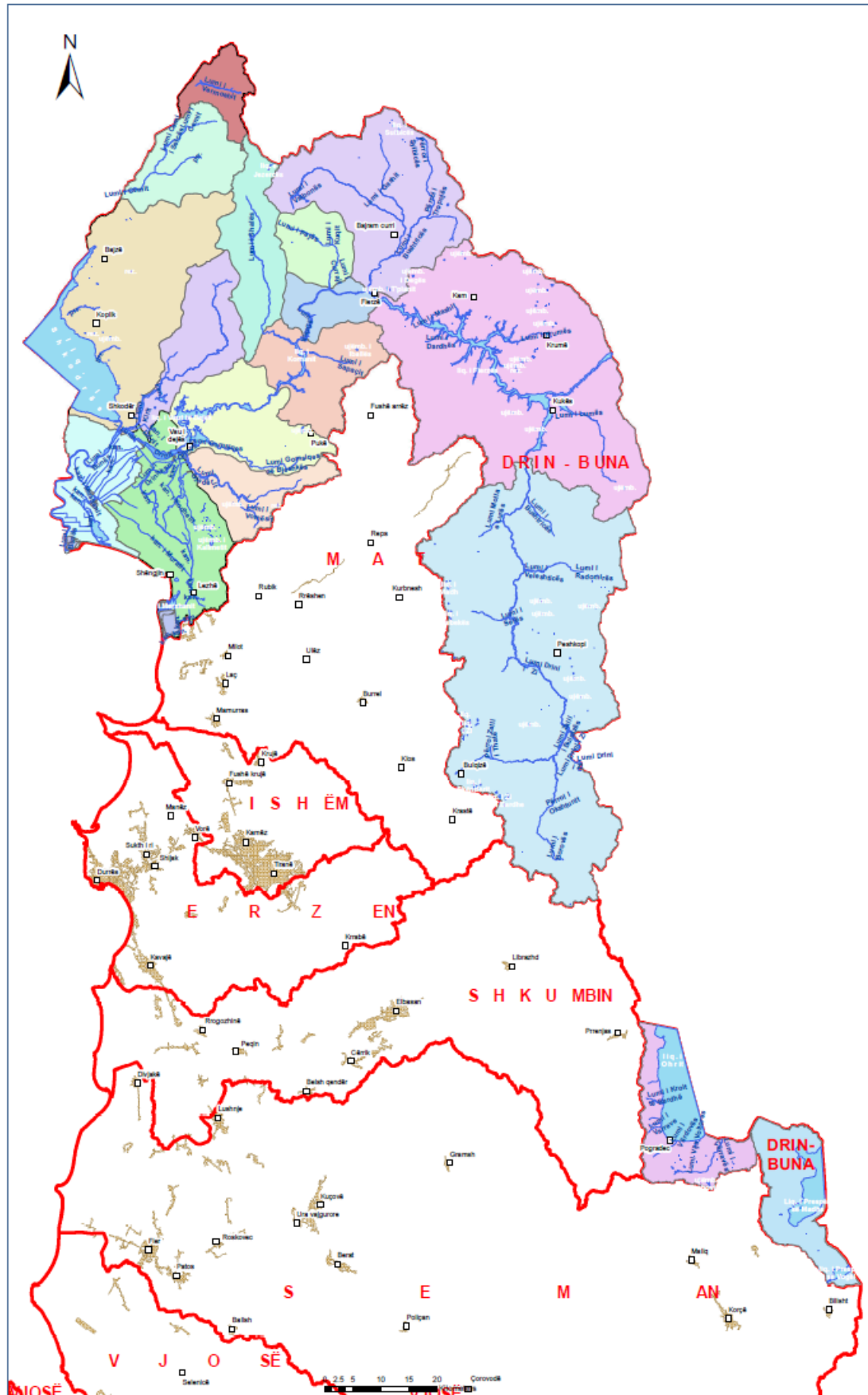
The major tributaries and their respective areas in the Drin-Buna River Basin are shown in Table 2.

Table 2 - Main sub-basins of the Drin-Buna River Basin.

River	Main tributaries / sub-basins	Length (km)	Drainage Basin Area (km ²)	Mean Altitude a.s.l (m)	Average flow (m ³ /s)
Drin	White Drin	134	4,964	862	68.2
Drin	Black Drin	149	3,504	1,132	118
Drin	Drin main branch	285	11,756	971	352
Buna	Buna main branch	1.5	5,187		320
Drin + Buna	Confluence	32.5	19,582	770	680

Administrative regions

The main administrative regions concerned are Shkodër, Kukës, Dibër, Lezhë and Korçë. The lower basin around Shkodër, Lake Shkodra, the Drin-Buna confluence, Velipojë and the Adriatic coast is especially important for flood management, wetlands, tourism, agriculture and protected areas



Map 1 - Map of the Drin-Buna River Basin (administrative boundary).

4.2 Drin-Buna Transboundary River Basin

4.2.1 Transboundary context and cooperation

The Drin-Buna River Basin is part of the wider transboundary Drin system in the Western Balkans. It connects Albania with Montenegro, North Macedonia, Kosovo and Greece through a network of rivers, lakes, wetlands, aquifers, transitional waters and coastal waters draining towards the Adriatic Sea. The wider Drin system comprises the Black Drin, White Drin, Drin and Buna rivers, the Prespa, Ohrid and Shkodra lakes, and associated groundwater systems. This hydrological continuity makes the basin a single functional water system, while its management responsibilities are divided across national jurisdictions²⁰.

In a WFD context, this transboundary setting is central to the preparation of the River Basin Management Plan. The WFD is based on river basin districts rather than administrative boundaries and requires cooperation between neighbouring countries sharing rivers, lakes and groundwater bodies. RBMPs and Programmes of Measures are the main tools to protect, restore and prevent deterioration of water bodies. For Albania, this means that characterisation, monitoring, status assessment, environmental objectives and measures in the Drin-Buna River Basin should be aligned, where relevant and feasible, with neighbouring countries.

Albania participates in basin-wide cooperation through the Drin Memorandum of Understanding, signed in Tirana on 25 November 2011. The MoU established the political framework for coordinated action among the Drin riparian's and created an institutional structure including the Meeting of the Parties, the Drin Corda Group (DCG) and expert working groups on WFD implementation, monitoring and information exchange, biodiversity and ecosystems. GWP-Med acts as Secretariat to the Drin Corda Group. This cooperation provides a practical platform for implementing the integrated water resources management approach required for this RBMP, including common data exchange, joint fact finding, harmonisation of assessment methods and coordination of measures.

Specific bilateral and sub-basin cooperation is also relevant. Albania and Montenegro cooperate on Lake Shkodra and the Buna River, where a 2008 agreement established cooperation on protection and sustainable development, supported by a Lake Shkodra Commission, joint secretariat and thematic working groups²¹. Cooperation with North Macedonia is particularly relevant for Lake Ohrid and the Black Drin system, while cooperation with Kosovo is relevant for the White Drin system and upstream pressures entering Albania. This international cooperation should be maintained and strengthened during the following RBMP cycles to support coherent monitoring networks, comparable classification, coordinated flood and drought management, and harmonised Programmes of Measures.

4.2.2 Transboundary water system

The Drin-Buna system functions as an interconnected source-to-sea water system. Lake Ohrid drains through the Black Drin, while the White Drin originates in Kosovo; both rivers meet near Kukës in Albania to form the Drin. Downstream, the Drin is strongly linked to Lake Shkodra and the Buna River, which forms part of the Albania–Montenegro border before reaching the Adriatic Sea. The hydrological connection between the Drin, Lake Shkodra and the Buna determines seasonal water levels, flow dynamics and delta morphology. Releases from major hydropower dams in the Albanian Drin system also influence the hydrological regime of Lake Shkodra and the Buna.

The basin has high ecological value. Lake Ohrid is a UNESCO World Heritage property and one of Europe's ancient lakes, with more than 200 endemic species and high sensitivity to changes in water quality, nutrient loads and wastewater pressures²². The Albanian part of Lake Shkodra and the wetlands along the Buna River, including the Viluni lagoon near Velipoja, were designated as a Ramsar site covering 49,562 hectares²³. These protected areas underline the need to integrate WFD objectives with

²⁰ <http://drincorda.iwlearn.org/drin-river-basin/introduction>

²¹ <https://archive.iwlearn.org/drincorda.iwlearn.org/drin-river-basin/geography-hydrology-and-hydrogeology-1/lake-skadar-shkoder.html>

²² <https://whc.unesco.org/en/list/99/>

²³ Albania designates third Ramsar site on World Wetlands Day 2006 (medwet.org).

conservation objectives for protected habitats, species, wetlands, bathing waters, drinking water resources and fisheries.

The system also provides important ecosystem services: drinking water supply, irrigation, fisheries, hydropower, tourism, flood retention, biodiversity conservation and coastal protection. These uses are interdependent. Upstream flow regulation, sediment trapping, wastewater discharges, agricultural runoff, solid waste, hydro morphological changes and groundwater–surface water interactions can create downstream effects across borders. The Drin Transboundary Diagnostic Analysis (TDA)²⁴ is a core document that provides necessary information that enables Drin riparians to discuss and identify priority transboundary problems and their causes which inform the formulation of the actions. The TDA identified deterioration of water quality, variability of the hydrological regime, biodiversity degradation and sediment transport as key transboundary problems.

For the Drin-Buna RBMP, the practical implication is clear: surface water bodies, groundwater bodies, protected areas and coastal/transitional waters cannot be assessed only within national boundaries. Albania will use this RBMP to define its national objectives and measures, while actively coordinating with neighbouring countries on shared monitoring, pressure-impact assessment, ecological and chemical status classification, flood and drought risks, sediment continuity, environmental flows and hydropower operation. This will help ensure that national measures contribute to basin wide WFD objectives and that transboundary pressures are addressed through a coherent Programme of Measures.

4.3 River Basin Baseline Characterization

4.3.1 Topography

The Drin-Buna River Basin is characterised by a strong topographical gradient from high mountain areas in the upper and middle basin to low-lying plains, floodplains and coastal areas near Lake Shkodra, the Buna River and the Adriatic Sea. The wider Drin Basin has a mean elevation of approximately 971 m above sea level, while the highest mountain peaks exceed 2,500 m; the elevation range extends down to sea level in the coastal zone. This relief structure is a defining feature of the basin and strongly controls runoff generation, river gradients, sediment transport, erosion potential and flood behaviour²⁵.

The upper parts of the basin are dominated by mountainous and karstic terrain, including the headwater areas of the Black Drin and White Drin systems. These areas contain steep slopes, deeply incised valleys and relatively fast hydrological response to intense rainfall and snowmelt. The mountainous relief increases the potential for soil erosion, landslides, flash runoff and sediment mobilisation, particularly where natural vegetation is degraded or where roads, mining, forestry or hydropower infrastructure disturb slopes and river corridors. The middle basin contains major valleys, reservoirs and tributary systems that convey runoff and sediment towards the Albanian Drin system and Lake Shkodra.

Downstream, the topography changes markedly. Around Shkodra, Lake Shkodra and the Buna River, the basin opens into low-gradient plains and floodplain areas. The Buna River forms the only outflow of Lake Shkodra and drains towards the Adriatic Sea, passing through a mainly flat area that is highly sensitive to backwater effects, high lake levels, river discharges and coastal water levels.

For the RBMP, topography provides an essential spatial baseline for hydrological analysis, water body delineation, pressure assessment and Programme of Measures design. Steep upland areas require attention to erosion control, sediment management, hydro morphological continuity, forest cover and torrent regulation. Lowland and floodplain areas require attention to flood storage, drainage, wetland conservation, river–lake interactions, groundwater–surface water exchange and climate-resilient land use planning. The topographical setting of the Drin-Buna River Basin is presented in **Map x**.

²⁴ The Drin TDA followed GEF best practice on TDA development. The development and drafting process of the Drin TDA was carried out between July 2016 and December 2018: The-drin-transboundary-diagnostic-analysis

²⁵ <https://archive.iwlearn.org/> – Geography, Hydrology and hydrogeology, Drin Corda

4.3.2 Land Use

Land use in the Drin-Buna River Basin has been assessed using CORINE Land Cover data. CORINE (Coordination of Information on the Environment), provides a harmonised European land cover inventory with 44 thematic classes and was originally developed as a cartographic product at a scale of 1:100,000; it is now part of the Copernicus Land Monitoring Service and is updated periodically, with the most recent complete CORINE Land Cover status layer referring to 2018²⁶.

The CORINE data show that the wider Drin-Buna basin is predominantly a natural and semi-natural basin. Forests and semi-natural areas form the dominant land cover, especially in the mountainous upper and middle parts of the basin. Agricultural land is concentrated mainly in valleys, plains and lowland areas, including irrigated and mixed farming zones. Water bodies, including Lake Shkodra, Lake Ohrid, reservoirs, rivers, wetlands and coastal lagoons, form a distinct and ecologically important land cover category. Artificial surfaces remain relatively limited at basin scale and are mainly associated with urban settlements, transport corridors, industrial areas and local infrastructure. A CORINE-based assessment for the extended Drin basin indicates an approximate distribution of 69.3% forests, 25% agriculture, 4% water bodies and 1.7% artificial surfaces²⁷.

The latest CORINE land use cover for the Drin-Buna River Basin is presented in **Map x**.

For the RBMP, this land use baseline is relevant for both WFD planning and Strategic Environmental Assessment. It helps identify the spatial relationship between pressures, economic activities and sensitive water-dependent ecosystems. Agricultural areas are relevant for assessing nutrient losses, pesticide use, irrigation demand, drainage and soil erosion. Forest and semi-natural areas are relevant for water retention, erosion control, ecological connectivity and reference conditions. Artificial surfaces indicate potential pressures from urban wastewater, stormwater, solid waste, transport and industrial activities. Wetlands, lakes, rivers and coastal areas require specific attention because they combine high ecological value with sensitivity to hydrological alteration, pollution and land use change. CORINE therefore provides a consistent spatial baseline for identifying pressures and risks, designing proportionate Programmes of Measures, minimising unnecessary impacts on economic activity, and ensuring that plan implementation remains consistent with the WFD objective to protect, restore and prevent deterioration of water bodies²⁸.

4.3.3 Geology and Soils

The Drin-Buna River Basin is geologically heterogeneous, with strong contrasts between the mountainous upstream areas, the karstic lake and river systems, and the lowland alluvial and coastal plains. The upper and middle parts of the basin include extensive carbonate and karst formations, especially in the Dinaric-Albanian mountain zones²⁹ and in parts of the White Drin and Lake Shkodra systems. The White Drin is hydraulically connected with the shared karstic Drini Bardhë aquifer, while Lake Shkodra lies in karst terrain in the south-eastern Dinaric Alps.

These karst and fractured rock systems are important for groundwater recharge, spring discharge and drinking water supply, but they are also vulnerable to rapid contaminant transport. In karst areas, pollutants can move quickly through fissures, conduits and sinkholes, with limited natural filtration. This makes groundwater protection zones, monitoring of springs and abstraction wells, and control of land-based pollution essential elements of the RBMP. Albania has extensive karst aquifers hosted in carbonate and evaporite rocks; these systems show significant variation in groundwater level, spring discharge and water quality in response to hydrometeorological conditions³⁰.

²⁶ <https://www.eea.europa.eu/en/analysis/publications/cor0-landcover>

²⁷ <https://www.mdpi.com/2306-5338/8/1/7> - River Flow Alterations Caused by Intense Anthropogenic Uses and Future Climate Variability Implications in the Balkans, MDPI, 2021.

²⁸ <https://environment.ec.europa.eu/>

²⁹ The Dinaric-Albanian mountain zone extends for approximately 645 kilometres along the western Balkan Peninsula from the Julian Alps of northeast Italy and northwest Slovenia, downwards to the Šar and Korab massif, where their direction changes. The Accursed Mountains are the highest section of the entire Dinaric Alps; this section stretches from Albania to Kosovo and eastern Montenegro. Maja Jezercë, standing at 2,694 metres (8,839 ft) above the Adriatic, is the highest peak located in Albania.

³⁰ <https://www.mdpi.com/2306-5338/9/7/127> - Karst Brackish Springs of Albania, MDPI, 2022.

In the lowland parts of the basin, especially around Shkodra, Lake Shkodra, the Buna River and the coastal zone, groundwater occurs mainly in intergranular alluvial, fluvial and deltaic deposits. The Shkodra Plain contains a thick intergranular aquifer covered by finer-grained soils, and groundwater generally flows towards Lake Shkodra. These aquifers are important for water supply but are sensitive to pollution from urban wastewater, agriculture, landfills, mining areas and uncontrolled development near wellfields³¹. The Shkodra–Buna transboundary aquifer system has therefore been subject to WFD-oriented groundwater body identification, vulnerability mapping, proposed monitoring zones and assessment of vulnerability to both land-based contamination and saltwater intrusion³².

Soil conditions reflect the same spatial pattern. Steep upland areas generally have shallow, stony and erosion-sensitive soils, particularly where vegetation cover is degraded or slopes are disturbed by roads, forestry, mining or hydropower infrastructure. Valleys, plains and floodplains contain deeper alluvial and colluvial soils³³ with higher agricultural potential and greater water retention capacity, but also higher exposure to nutrient losses, pesticides, drainage pressures and flood-related contaminant mobilisation. Wetland and hydromorphic soils occur around lakes, floodplains, lagoons and the coastal delta system. For the RBMP, geology and soils provide a key basis for groundwater body delineation, recharge assessment, erosion risk mapping, drinking water protection, diffuse pollution assessment and the design of targeted measures under the Programme of Measures. The geological and soil characteristics of the Drin-Buna River Basin are presented in **Map x**.

4.3.4 River and Coastal Morphology

The Drin-Buna River Basin includes a wide range of natural and modified hydro morphological conditions, from steep mountain rivers and incised valleys in the upper catchments to reservoirs, large lakes, lowland floodplains, transitional waters and the Adriatic coastal zone. In its natural state, the river system would be characterised by strong seasonal flow variability, high sediment transport from mountainous tributaries, active riverbank erosion, lateral floodplain exchange and dynamic deltaic processes near the Buna mouth. The Lake Shkodra–Buna system is particularly important because the Buna River is the only outflow from Lake Shkodra and forms the hydraulic connection between the lake, the Drin and the Adriatic Sea. The delta and coastal zone include freshwater, brackish and coastal habitats, including marshes, reedbeds, dunes, lagoons, floodplain forests and wet pastures.

The physical structure of the basin has been significantly modified, especially along the main Drin River. In northern Albania, the Drin has been transformed into several artificial lakes: Fierza, Koman and Vau i Dejës; serving major hydropower plants in the Drin cascade. KESH identifies the Drin as transformed into these reservoirs, with the cascade comprising Fierza HPP, Koman HPP and Vau i Dejës HPP, with substantial installed hydropower capacity³⁴. These dams and reservoirs regulate flows, interrupt longitudinal river continuity, trap sediment, alter water levels and change downstream flow variability. Basin-wide assessments indicate that the hydrology of the extended Drin Basin has been strongly altered by hydropower development, with consequences for flow regime, riverbank erosion, induced sedimentation and former wetland areas³⁵.

Downstream, the hydro morphology of the Buna and Lake Shkodra system is controlled by the combined effects of lake levels, Drin discharges, reservoir operation, sediment deposition, low channel gradients and coastal water levels. Under high Drin flows, the outflow from Lake Shkodra through the Buna can be impeded, increasing flood risk in the lowland area. The Drin also deposits sediment near the confluence, which can further obstruct the Buna outflow and affect lake water levels and floodplain inundation patterns. Embankments, irrigation and drainage networks, urban development, sand and gravel extraction, bank protection, local channel modifications and infrastructure further reduce natural

³¹ <https://www.preprints.org/manuscript/202308.1491> - Hydrogeological Aspects of the Municipal Water Supply of Albania: Situation and Problems, Preprints.org, 2023.

³² <https://ihp-wins.unesco.org/memberstates/albania> - Albania - Groups - IHP Water Information Network System (IHP-WINS)

³³ Colluvial soils is a general name for loose, unconsolidated sediments that have been deposited at the base of hillslopes by either rainwash or slow continuous downslope creep, or a variable combination of these processes. This term is also used to specifically refer to sediment deposited at the base of a hillslope by unconcentrated surface runoff or erosion.

³⁴ <https://www.kesh.al/en/service/drin-cascade/> - Drin Cascade, KESH

³⁵ <https://gwpo-gwp.org/stories-of-change/europe-stories-of-change/enabling-transboundary-co-operation-and-integrated-water-resources-management-in-the-extended-drin-river-basin/> - Enabling Transboundary Co-operation and Integrated Water Resources Management in the Extended Drin River Basin, GWPO-GWP, 2021.

floodplain connectivity and may affect habitat diversity, spawning areas, riparian vegetation and sediment continuity.

For the WFD characterisation, hydromorphological alteration is therefore assessed at waterbody level, distinguishing between relatively natural mountain streams, regulated river reaches, reservoirs, lakes, floodplain channels, transitional waters and coastal waters. Key assessment parameters are flow regime, river continuity, lateral connectivity, channel form, bed substrate, bank structure, riparian zone condition, sediment balance and the presence of barriers or bank protection. The hydromorphological setting of the Drin-Buna River Basin is presented in **Map x**.

4.3.5 Ecoregions and Biodiversity

According to the WFD Annex XI System A typology for rivers and lakes, the Drin-Buna River Basin falls within the so-called *Ecoregion 6: Hellenic Western Balkan*. The ecoregion is characterised by a combination of mountainous catchments, karst geology, short and steep river systems, large tectonic and karst lakes, Mediterranean and continental climatic influences, and high ecological diversity. The transitional and coastal waters of the Buna mouth and the adjacent Adriatic coastal zone belong to the *wider Mediterranean Sea ecoregion* for coastal and transitional water typology. This ecoregional setting is important for defining reference conditions, water body typology and ecological assessment methods under the WFD³⁶.

The basin has very high biodiversity value because it connects mountain rivers, karst springs, large ancient lakes, reservoirs, floodplains, wetlands, lagoons, estuaries and coastal waters. Lake Ohrid is one of Europe's oldest and most species-rich lakes and is recognised as a UNESCO World Heritage property. Its oligotrophic waters support more than 200 endemic plant and animal species, including endemic algae, flatworms, snails, crustaceans and fish species such as Ohrid trout. Lake Shkodra and the Buna wetlands provide extensive shallow-water, reedbed, riparian, floodplain and delta habitats, with high importance for fish, amphibians, aquatic vegetation and migratory and wintering birds. The Albanian part of Lake Shkodra and the River Buna wetlands, including the Viluni lagoon, designated as a Ramsar site.

The Drin system is also recognised for its endemic-rich fish fauna, and the Drin lakes alone host many endemic species. The river-lake-coastal connectivity of the basin is therefore ecologically important for migration, genetic exchange and the functioning of aquatic ecosystems. Riparian forests, floodplain wetlands, karst springs and coastal lagoons further increase habitat diversity³⁷.

4.3.6 Protected Areas

Protected areas in the Drin-Buna River Basin are regulated under Law No. 29/2024 on Water Resources and align with WFD Article 6 and Annex IV. They encompass zones for water supply protection, fisheries, nature conservation, and other areas of special ecological or socio-economic value. Task Report 2 contains the full Register of Protected Areas, also summarized in Chapter 13.

Their designation and management ensure the alignment of Albania's river basin planning with EU water and biodiversity policies. The register includes five categories as follows:

- Drinking water abstraction zones
- Areas designated for the protection of economically significant aquatic species
- Recreational (bathing) waters
- Nutrient-sensitive zones (e.g. nitrate vulnerable zones)
- Natura 2000 sites and nationally designated nature protection areas

³⁶ WFD Annex XI lists Ecoregion 6 as "Hellenic Western Balkan" for rivers and lakes and identifies the Mediterranean Sea as an ecoregion for transitional and coastal waters under System A. (EUR-Lex)

³⁷ <https://www.feow.org/global-maps/biodiversity>

5 Hydrological Baseline Characterization

This chapter provides the hydrological baseline, covering climate, hydrometeorology, surface water and groundwater systems, floods, droughts, and observed and projected climate change impacts. A further focus lies on water use and water services, including drinking water supply, agriculture, irrigation and drainage, industrial water use, hydropower, dams, reservoirs, and wastewater infrastructure.

Additional background, technical information, and data are presented in the Task Reports 1, 2, 8, 9 and 12.

5.1 Climate and Meteorology

5.1.1 General outline

Albania lies within the subtropical belt of the Mediterranean, where climate conditions are strongly influenced by its position along the Adriatic and Ionian Seas and by the country's rugged relief. The Mediterranean climate is characterized by mild, wet winters and hot, dry summers, with most of the annual precipitation concentrated between October and May. The spatial variability of precipitation and temperature across the country is controlled primarily by altitude and exposure to maritime air masses.

In Köppen terms this is the dry-summer temperate (Cs) regime, predominantly Csa/Csb, occurring on the western flanks of continents between 30°–45° latitude^{38,39,40}. Summer dryness reflects the poleward expansion of subtropical highs; winter wetness is linked to the passage of frontal cyclones.

The climate of the Drin–Buna River Basin is shaped by the interplay between a Mediterranean atmospheric regime and a pronounced topographic gradient. Located within the subtropical Mediterranean belt of south-eastern Europe, the basin experiences fundamentally Mediterranean seasonality, characterised by wet, mild winters and warm, dry summers, yet this pattern is substantially modified by elevation, relief orientation, and valley structure. These factors jointly govern the spatial distribution of temperature and precipitation as well as the temporal variability of the hydrological regime across annual and multi-annual scales.

From the Buna lowlands at near sea level to the high alpine headwaters of the Drin system, the basin exhibits a clear vertical zonation of climatic conditions. Maritime air masses originating from the Adriatic Sea dominate the lower elevations, delivering mild winters and abundant rainfall. As these air masses are forced upward over progressively higher terrain, orographic lifting enhances precipitation and reduces air temperatures, increasing the proportion of snowfall and the duration of snow cover. Simultaneously, major river valleys act as conduits for atmospheric circulation, channelling both warm maritime air and cold continental air inland, particularly during winter. The resulting climatic pattern is therefore neither spatially uniform nor purely zonal, but structured by relief and exposure, with marked transitions occurring over relatively short distances.

Within the Albanian climatic regionalisation framework^{41,42}, the Drin–Buna basin intersects several Mediterranean climate zones and subzones. The basin is principally associated with:

- I. The Northern subzones of the Lowland Mediterranean Zone
- II. Hilly Mediterranean Zone
- III. Sub-mountain Mediterranean Zone, and;

³⁸ Encyclopaedia, B. Mediterranean climate | Definition, Region, Map, & Facts. 2009 2009/08/28; Available from: <https://www.britannica.com/science/Mediterranean-climate>.

³⁹ Kottek, M., et al., World Map of the Köppen-Geiger climate classification updated. Meteorologische Zeitschrift, 2006. 15(3): p. 259-263.

⁴⁰ Peel, M.C., B.L. Finlayson, and T.A. McMahon, Updated world map of the Köppen-Geiger climate classification. Hydrology and Earth System Sciences, 2007. 11: p. 1633-1644.

⁴¹ Mici, A., Zotaj, P., Bica, P. and Manushaku, M. (1975). Klima e Shqipërisë. Tirana.

⁴² Pano, N. (2015). Pasuriët ujore të Shqipërisë. Tirana: Academy of Sciences of Albania.

IV. Mediterranean Mountain Zones.

This climatic diversity underpins the basin's complex hydrological behaviour and necessitates a spatially differentiated analytical approach.

5.1.2 Mediterranean Lowland Climate Zone: The Buna and Lower Drin

The lowland areas encompassing the Buna River corridor and the lower Drin represent the warmest and most maritime-influenced portion of the basin. Situated at elevations generally below 200 m a.s.l., this zone receives mean annual precipitation of approximately 1,300–1,700 mm, making it one of the wettest lowland areas in the Mediterranean basin. Winters are mild (mean January temperature approximately 5–7°C) and summers warm to hot (mean July temperature approximately 24–26°C). Precipitation falls almost entirely as rain throughout the year, and the hydrological regime is dominated by rainfall-generated runoff with negligible snow contributions. The proximity to Lake Shkodra and the Adriatic coast moderates diurnal and seasonal temperature extremes, resulting in relatively low diurnal temperature ranges (DTR) compared to interior stations.

5.1.3 Mediterranean Hilly Climate Zone: The Northern Foothills

At intermediate elevations (roughly 200–800 m), the hilly terrain of the northern and north-eastern basin margins exhibits a transitional climate. Mean annual precipitation typically exceeds 1,300 mm, with a significant proportion of winter precipitation falling as mixed rain–snow at the higher end of this elevation band. Temperatures are lower than in the lowlands by 2–4°C on average, following the environmental lapse rate. This zone is characterised by a mixed hydrological response: runoff is predominantly rainfall-driven but with meaningful contributions from transient snowpack in cold winters. The shorter growing season and lower summer temperatures relative to the lowlands result in somewhat reduced evapotranspiration demand, contributing to a more favourable water balance at the annual scale.

5.1.4 Mediterranean Pre-Mountain Climate Zone: The Drin Valley System

The pre-mountain zone, encompassing the middle reaches of the Drin valley system at elevations of approximately 600–1,200 m, experiences more pronounced continental characteristics within the broader Mediterranean framework. Mean annual temperatures are 2–6°C lower than in the lowlands, and winter temperatures regularly fall below freezing, establishing a reliable seasonal snowpack at the upper margins of this zone. The Drin valley system, oriented roughly east–west, acts as a corridor for both maritime and continental air masses, creating locally complex precipitation patterns. Cold air drainage down the valley during winter nights produces frequent temperature inversions, while the funnelling of south-westerly maritime air masses can generate localised precipitation maxima on the windward slopes.

5.1.5 Mediterranean Mountain Climate Zone: The Alpine Headwaters

The highest parts of the basin, including the Albanian Alps (Bjeshkët e Namuna / Prokletije) and the mountain ranges surrounding the upper Drin tributaries, experience a true mountain Mediterranean climate, with long cold winters, short cool summers, and abundant precipitation. Mean annual precipitation at the highest stations reaches approximately 2,500–2,700 mm, making this one of the wettest areas in continental Europe. A substantial fraction of winter and early spring precipitation falls as snow, and snow cover may persist for 4–6 months above 1,500 m. Mean annual temperatures at summit stations are approximately 3–6°C, and the frost season extends from October to April. The mountain zone is the primary water storage reservoir for the basin, with snowmelt constituting the dominant contribution to spring and early summer river flows in the Drin system.

5.1.6 Climatic Implications for the Hydrological Regime

The vertical zonation from pluvial (rainfall-dominated) regimes at low elevations through nival-pluvial (snow-and-rain) at intermediate elevations to nival (snow-dominated) regimes in the alpine headwaters creates a complex multi-source hydrological system. The phased timing of precipitation inputs, with lowland runoff responding immediately to autumn–winter rainfall while mountain snowmelt delivers water with a delay of weeks to months, provides a natural temporal buffering that extends the period of high river flows from autumn through to late spring. This phasing is a critical feature for water resources management, as it sustains baseflows and reservoir inflows during the transition from the wet to the dry

season. Climate change, specifically, rising temperatures and their effects on the rain–snow partition, snowmelt timing, and evapotranspiration, has the potential to alter this phasing, reducing the natural storage function of the mountain snowpack and concentrating runoff into a shorter period.

Table 3 - Characteristics of Mediterranean climatic sub-zones within the Drin-Buna River Basin.

Climate Zone / Sub-zone	Spatial Coverage in Drin-Buna Basin	Mean Temperature (°C)	Precipitation (mm / year)	Rainy Days (per year)	Snow / Frost Characteristics	Other Key Climatic Features
I. Lowland Mediterranean – Central sub-zone	Buna River corridor and the lower Drin	5–7 (winter) 24–26 (summer)	1,300–1,700		Snow negligible; 15 – 30 frost days	Strongest winds nationally; high evaporation; storm waves can impede river outflow during floods
II. Hilly Mediterranean – Central sub-zone	The hilly terrain of the northern and north-eastern basin	3 (winter) 22 (summer)	exceeds 1,300		20 - 30 frost days; 7 - 10 snow-cover days	Winter > autumn rainfall; mostly rain (SW exposure); moderate spatial uniformity of annual rain
III. Sub-mountain Mediterranean - Southern sub-zone	Middle reaches of the Drin valley system	1-2 (winter) 20–22 (summer)	locally complex precipitation patterns; exceeds 1,300		100 - 110 freezing days	Cold snowy winters, warm dry summers; strong influence of altitude and valley orientation
IV. Mountain Mediterranean - South-Eastern sub-zone	Albanian Alps and the mountain ranges surrounding the upper Drin tributaries	3–6 (mean annual)	2,500–2,700		Regular but moderate snowfall; snow cover may persist for 4–6 months	Among Albania's drier mountain regions; retains Mediterranean seasonality but more continental

5.2 Climatic elements defining the hydrological regime in the Drin-Buna Basin

5.2.1 Precipitation

The precipitation regime of the Drin–Buna basin is characterised by high mean annual totals (basin average 1,464 mm), strong spatial gradients driven by orography (763 – 2,521 mm), and pronounced Mediterranean seasonality with 64% of precipitation concentrated in autumn and winter. Over the 1982–2024 analysis period, no statistically significant trends were detected in annual or seasonal totals, either at the basin scale or at the majority of individual stations. Precipitation indices (R10mm, SDII, MLDS) also show no significant basin-wide trends, indicating that neither the total amount nor the daily character of precipitation has changed detectably over the study period.

The spatial analysis reveals that the basin's precipitation regime is fundamentally shaped by its topography and exposure to maritime air masses. The more than threefold range in annual totals, from the rain-shadow interior to the orographically enhanced alpine zone, means that any basin-average statistic conceals enormous local variation. For water management purposes, the spatial distribution matters as much as the temporal trend: the wettest areas generate the runoff that sustains downstream users, while the driest areas are already marginal for rain-fed agriculture and are most vulnerable to any future drying.

The 100-year return period daily maximum ranges from 72 mm to 284 mm depending on location, providing essential design values for flood protection infrastructure.

The stationarity of the precipitation regime, combined with the strong warming trends, means that the primary climate-driven pressure on the basin's water resources is not a decline in water supply but rather an increase in atmospheric evaporative demand, a distinction critical for adaptation planning. The precipitation analysis also provides the baseline for the drought assessment and the water balance

computation, both of which depend on reliable characterisation of precipitation inputs (see also Task Report 9).

5.2.2 Air temperature

The Drin–Buna Basin has warmed by approximately $+0.47^{\circ}\text{C}$ per decade over 1982–2024, with all 57 stations showing statistically significant upward trends. This rate slightly exceeds the Mediterranean regional average of approximately $+0.4^{\circ}\text{C}$ per decade, placing the basin firmly within the Mediterranean “climate change hotspot” identified by the IPCC. A synchronous change-point in 2006 detected by the Pettitt test marks the onset of accelerated warming, aligning with the broader acceleration of warming observed across south-eastern Europe in the mid-2000s.

Summer shows the strongest warming ($+0.06^{\circ}\text{C}/\text{yr}$), which is particularly consequential for water resources because it coincides with the season of maximum evaporative demand and minimum precipitation. The period comparison reveals a $+0.91^{\circ}\text{C}$ increase in annual T_{mean} between the baseline (1982–2002) and recent (2003–2024) periods. This near -1°C warming carries multiple hydrological implications: it elevates the rain–snow transition altitude by approximately 150 m, reduces the volume of seasonal snowpack, and extends the growing season, all of which alter the timing and magnitude of runoff generation.

Frost days are declining sharply (-0.75 days/yr) while hot days ($T_{\text{max}} > 35^{\circ}\text{C}$), tropical nights ($T_{\text{min}} > 20^{\circ}\text{C}$), and the growing season are all increasing significantly. The decline in frost days reduces the period of frozen soils, potentially increasing winter infiltration and reducing spring snowmelt peaks. Conversely, the increase in hot days intensifies peak evaporative demand and heat stress on vegetation, while the expansion of tropical nights indicates that nighttime recovery from heat stress is diminishing, a factor with implications for both ecosystem health and urban energy demand. These temperature trends drive the increases in evaporative demand and the narrowing water balance further discussed and documented in Task Report 9.

5.2.3 Evapotranspiration

Evapotranspiration in the Drin–Buna Basin follows a pronounced seasonal pattern. During autumn, winter and early spring, sufficient water is generally available to meet atmospheric demand. In summer, however, high temperatures and solar radiation strongly increase water losses, while available soil moisture declines. In July, potential evapotranspiration reaches approximately 178 mm, while actual evapotranspiration is only about 22% of this amount. This large difference indicates substantial summer water stress for vegetation, soils and aquatic ecosystems, which is characteristic of the basin’s Mediterranean climate.

Climate warming is increasing both potential and actual evapotranspiration. Over the 43-year assessment period, potential evapotranspiration increased by approximately 155 mm, equivalent to about 10% of the current annual total. Actual evapotranspiration also increased, partly because higher temperatures have extended the growing season and the period during which vegetation actively uses water.

This increase in evaporation and plant water use is an important pressure on the basin’s water resources. Even where annual precipitation remains stable, more water is returned to the atmosphere, leaving less water available for river flows, groundwater recharge and ecosystems. This process can be described as an “evaporative squeeze” on the basin’s water balance. The effects are expected to be greatest in the warmer lowland areas, where evaporative demand and seasonal water deficits are already highest. Further analysis of the consequences for the overall water balance is presented in Task Report 9.

5.2.4 Air humidity

Humidity fields modulate both precipitation potential and evapotranspiration demand. Absolute humidity generally decreases from the maritime plain toward the interior and from south toward north and decreases with altitude because vapour pressure falls with height by roughly 0.5 mb per 100 m. Relative humidity tends to be higher during the cool season and lower in summer. The coastal lowland exhibits

smaller annual amplitudes of relative humidity than interior continental areas, where summer deficits are larger. The seasonal deficit of atmospheric humidity increases from winter to summer and from the coast toward inland valleys, enhancing evapotranspiration particularly across the plain and lower hills.

5.2.5 Wind regime

The wind regime affects both moisture transport and open water/soil evaporation. Over the Drin-Buna lowland and adjacent coast, mean wind speeds are among the highest nationally, which favours high evaporation rates and can generate coastal storm waves that occasionally impede river outflow during major floods. Regionally, northerly winds are most frequent, followed by winds from the southern quadrants; easterly and westerly winds occur less often. Within the interior valleys, local topographic controls channel airflow and can intensify valley–slope circulations during clear-sky periods.

5.3 Hydrology and the Surface Water System

Table 4 provides an overview of the principal hydrological characteristics of the basin, consolidating key figures that are elaborated in the sub-sections that follow.

Table 4 - Key hydrological characteristics of the Drin–Buna River Basin.

Parameter	Value
Total catchment area	14,173 km ² (5,870 km ² in Albania)
Main stem length (Drin)	285 km
Elevation range	0–2,400 m a.s.l. (mean: 971 m)
Mean annual precipitation (basin avg.)	~1,200 mm/yr (range: 763–2,521 mm)
Mean annual runoff (outlet)	779 mm/yr
Mean annual evapotranspiration	422 mm/yr
Mean discharge at outlet (Bahçallëk)	350 m ³ /s (specific: 24.7 l/s·km ²)
Runoff coefficient	0.65 (range: 0.46–0.93 across sub-basins)
Surface water bodies delineated	65 (48 rivers, 9 lakes, 4 transitional, 4 coastal)
HMWB / AWB designations	17 (10 HMWB, 7 AWB)
Hydropower installed capacity	1,350 MW (Fierza–Koman–Vau i Dejës cascade)
Principal lakes	Shkodra (452 km ²), Ohrid (362 km ²), Prespa (259 km ²)
Analysis period (meteorology)	1982–2024 (43 years)
Analysis period (Drini Cascade)	2015–2024 (10 years, KESH data)

5.3.1 The Drin River System

The Drin River (Albanian: *Drini*) is the largest river in Albania and one of the principal rivers of the eastern Adriatic coast, both in terms of its catchment area and its discharge. The total catchment area of the Drin basin is approximately 14,173 km², of which about 5,870 km² lies within Albanian territory; the remainder is shared among Kosovo, North Macedonia, and Montenegro. The river has an overall length of approximately 285 km and a total elevation drop of about 685 m, corresponding to a mean gradient of approximately 2.4%.

The Drin is formed by the confluence of two major tributaries: the Drin i Zi (Black Drin), which originates from Lake Ohrid in North Macedonia and flows through a predominantly mountainous course before entering Albania, and the Drin i Bardhë (White Drin), which rises in Kosovo. These two rivers merge near the city of Kukës in northern Albania, after which the combined Drin flows generally westward through the deep gorges of the Albanian Alps toward the Adriatic lowlands. The confluence at Kukës marks one of the most important hydrological nodes in the basin, as it combines two fundamentally different flow regimes: the lake-regulated, relatively stable flow of the Drin i Zi with the more flashy, precipitation-responsive flow of the Drin i Bardhë.

The basin's mean elevation is approximately 971 m a.s.l., reflecting its predominantly mountainous character. The hypsometric distribution shows that elevations between 400 and 1,800 m a.s.l. cover approximately 65% of the catchment area, while lowlands below 400 m account for less than 10%. The

highest peaks in the Albanian Alps (Bjeshkët e Namuna / Prokletije) reach 2,400 m a.s.l., forming the basin's primary water storage zone through seasonal snowpack accumulation. The pronounced relief creates strong orographic precipitation enhancement, with annual totals exceeding 2,500 mm in the north-western mountains but dropping below 900 mm in the interior valleys.

After passing through the three-dam Drini Cascade (Fierza, Koman, and Vau i Dejës), the Drin reaches the coastal lowlands. Historically, the Drin has been remarkable for repeatedly changing its course: in various periods it has discharged either directly into the Adriatic through the Lezha channel (Drini i Lezhës) or into the Buna River approximately 1.5 km downstream of Lake Shkodra. Ancient accounts by Julius Caesar describe Shkodra as situated between the Buna and Kiri rivers, with no mention of the Drin flowing through that area. The last major avulsion occurred in 1858, when the Drin permanently shifted its course from Lezha to the Buna. Today, most of the Drin's discharge enters the Buna system, although the Drini i Lezhës channel still carries water during high-flow events.

5.3.2 Major Tributaries

The Valbona River is the largest alpine tributary of the Drin, draining a catchment of approximately 622 km² at Gri (and 172 km² at the upper Dragobi station). Originating in the Albanian Alps at the foot of Qafa e Valbonës, the Valbona exhibits a strongly alpine (nival-pluvial) hydrological regime: peak discharge occurs in April–May due to snowmelt, with a secondary autumn peak from rainfall, and minimum flows in August. Its specific discharge is among the highest in the basin at approximately 53 l/s·km² at Gri, reflecting the extreme precipitation (over 2,100 mm/yr) and steep, impermeable terrain of its catchment. The upper Valbona at Dragobi reaches an extraordinary 64.3 l/s·km², with a runoff coefficient of 0.93, meaning that only 7% of precipitation is lost to evapotranspiration in this high-altitude zone.

The Shala River drains approximately 200 km² including its Thethi tributary, flowing through one of the most spectacular and inaccessible gorges in the Albanian Alps. Like the Valbona, it contributes high-quality, snowmelt-influenced water to the Drin system. The Thethi sub-catchment (65 km², mean elevation 866 m) is particularly important as a pristine alpine reference system.

The Kiri River drains approximately 300 km² in the western foothills, with a mean specific discharge of approximately 65 l/s·km², among the highest in the basin due to exceptionally high local precipitation (nearly 2,900 mm/yr) on the Adriatic-facing slopes. Despite its moderate catchment size, the Kiri is hydrologically significant because it enters the Drin below the cascade and therefore its flow is unregulated, contributing to the natural variability of the lower Drin.

The Gjadër River (199 km²) drains the coastal hinterland west of the cascade. The **Gomsiqe River** (137 km², specific discharge 45.3 l/s·km²) enters the Drin between Koman and Vau i Dejës and has a runoff coefficient of 0.65, somewhat lower than the alpine tributaries. The **Luma River** (578 km² at Pobreg, specific discharge 22.5 l/s·km²) is significant as a transboundary tributary originating in Kosovo.

5.3.3 The Buna River

The Buna (Bojana in Montenegrin) is the only lowland river in Albania's hydrographic network. It is the outlet of Lake Shkodra, arising at the southern edge of the lake near the city of Shkodra. Just 1.5 km downstream of its origin, the Buna receives the full discharge of the Drin River. The Buna has a length of approximately 41 km and a very gentle gradient of about 1.2 m/km. The mean multi-year discharge of the Buna is estimated at approximately 320 m³/s at its mouth, making it one of the largest rivers discharging into the Adriatic Sea.

The Buna's hydrological character is unique: it integrates a regulated lake outflow with a heavily dammed river inflow. Lake Shkodra functions as a natural regulator of the Buna's discharge, buffering seasonal fluctuations through storage, while the Drini Cascade's operational releases can cause rapid short-term flow variations downstream. During periods of very high Drin discharge, the Buna can actually reverse direction in its uppermost reach, pushing water back into Lake Shkodra. The lake's outlet carries approximately 94% of its outflow; the remaining 6% is lost to evaporation (approximately 758 mm/yr from the lake surface).

5.3.4 Lake Shkodra

Lake Shkodra (Skadar) is the largest lake on the Balkan Peninsula, with a water surface area of approximately 452 km² (270 km² in Montenegro, 183 km² in Albania). The lake has a mean depth of 7 m, a maximum depth of 44 m, and a total volume at the mean multi-year water level of approximately 2.6 billion m³. Its catchment area is approximately 5,175 km², shared between Albania (roughly two-thirds) and Montenegro. The principal tributaries are the Morača and Zeta rivers from Montenegro, and the Cem, Kir, and Dry Stream (Përr. i Thatë) from Albania. The seasonal water level fluctuation is approximately 2 m.

The lake occupies a broad tectonic basin filled with alluvial sediments, bordered by the Tarabosh mountains to the west and the Shas mountains to the east. From a hydrogeological perspective, the area is characterised by a karstic aquifer system with numerous subterranean and sub-lacustrine springs that continuously supply freshwater to the lake. These karst springs are particularly important during the dry season when surface inflows diminish.

5.3.5 Lakes Ohrid and Prespa

Lake Ohrid, located on the Albanian–North Macedonian border, is one of the deepest and oldest lakes in Europe (maximum depth 289 m, surface area approximately 362 km², of which 108 km² in Albania). It is a tectonic lake of Pliocene origin with remarkably stable thermal stratification: surface temperatures range from approximately 5°C in winter to 24°C in summer, while deep water below 40 m remains at a nearly constant 7–8°C year-round. Lake Ohrid discharges into the Drin i Zi, constituting the upstream boundary of the Drin system within Albania. Its outflow is naturally regulated by the lake's large volume, producing a relatively stable contribution to Drin i Zi flows.

Lake Prespa consists of two connected lakes: Greater Prespa (45.8 km² in Albania) and Small Prespa (4.6 km²), at an elevation of approximately 845–850 m a.s.l. The Prespa system has no surface outlet; water drains underground through the karst system to emerge as springs feeding Lake Ohrid at approximately 693 m a.s.l., completing a unique hydrogeological connection across a 150-m elevation difference.

5.3.6 Hydrological Regime Characteristics

The flow regime of the Drin–Buna system is fundamentally Mediterranean in character but significantly modified by three factors: (1) the high altitude of the headwaters, which produces a nival-pluvial regime with spring snowmelt peaks; (2) the natural regulation provided by Lake Shkodra and Lake Ohrid; and (3) the artificial regulation imposed by the Drini Cascade. Under near-natural conditions, the seasonal flow pattern would feature high discharges in late autumn–winter (November–February) driven by rainfall, a secondary spring peak (April–May) from mountain snowmelt, and very low flows in summer (July–August). The Fierza reservoir substantially redistributes these flows.

The mean annual discharge at the basin outlet at Bahçallëk is approximately 350 m³/s (specific discharge: 24.7 l/s·km²), corresponding to a mean annual runoff depth of approximately 779 mm. This is high by European standards and reflects the basin's combination of abundant precipitation (basin-average approximately 1,200 mm/yr) and moderate evapotranspiration losses (approximately 422 mm/yr), yielding a runoff coefficient of approximately 0.65.

5.4 Hydrogeology and the Groundwater System

5.4.1 Hydrogeological characterization of the Drin Basin

From the hydrogeological point of view, the Drin Basin has a wide variety of water-bearing formations. The main importance for quantitative and qualitative monitoring is related to the alluvial-Quaternary water-bearing complex of Shkodra, Nenshkoder-Zadrime, Tropoja and Peshkopia, as well as to the carbonate springs of Tropoja, Pogradec, Kukes, Kruma and Malesia e Madhe.

The classification has been based on the water-bearing complexes, taking into account lithology, hydraulic conditions, water-bearing potential and their practical role in water supply and monitoring. Long or mixed formulations have been avoided in order to create a clearer and more technical division.

Alluvial-Quaternary water-bearing complex

This water-bearing complex represents one of the most important units of the Drin Basin. It is related to loose alluvial and proluvial deposits, mainly gravels, coarse gravels, sands and silts. This complex is of particular importance in the areas of Shkodra, Nenshkoder-Zadrime, Tropoja, Peshkopia, Koplik and Maqellare.

In the Shkodra area, gravel and coarse gravel deposits form important water-bearing horizons, mainly unconfined and widely distributed. In Nenshkoder-Zadrime, the system is divided into the Nenshkoder sector and the Zadrime plain sector. In Tropoja and Peshkopia, the alluvial deposits are closely related to the beds of the Valbona, Tropoja and Black Drin rivers, with good hydraulic connections to surface flows.

Water-bearing complex of magmatic and carbonate deposits with moderate potential

This water-bearing complex includes magmatic, ultrabasic and metamorphic formations, as well as some carbonate or sedimentary intercalations where groundwater circulation is linked to fracturing, lithological contacts and tectonic structures. The water-bearing potential is moderate and not always uniform, but it may be locally important in specific areas. This group includes massifs such as Tropoja, Kukes, Puka, Bulqiza and other areas where magmatic or carbonate formations create limited but important conditions for local groundwater circulation.

Carbonate water-bearing complex

The carbonate water-bearing complex is one of the most important units of the Drin Basin, especially for natural springs with considerable discharge. It includes limestone and dolomitic formations of different geological ages, which have similarities in lithology, fracturing and hydraulic connection. Springs such as Syri i Sheganit, Lini and Tushemishti are related to carbonate circulation, in some sectors with pronounced karst development. The term karstic is used only where it is necessary to emphasize the circulation mechanism and sensitivity to rapid pollution.

Practically non-aquifer formations

This group includes formations with low permeability and water-bearing capacity, where groundwater circulation is very limited. These formations do not have practical importance for regional water supply, but may present local occurrences with small discharges.

5.4.2 Groundwater use and resources

The Drin Basin has significant groundwater reserves, which are used for the water supply of towns and villages in northern and northeastern Albania. The main areas are Shkodra, Malesia e Madhe, Lezha, Tropoja, Puka, Kukes, Pogradec, Kruma and Peshkopia.

Shkodra area

The city of Shkodra is supplied mainly from the Dobrac area through hydrogeological wells. The Dobrac pumping station has a total discharge of about 1,000-1,100 l/s. The total quantity of water use from the Shkodra aquifer is about 1,200-1,300 l/s.

Table 5 - Main groundwater use in the Shkodra area.

Source / station	Discharge
Dobrac pumping station	1,000-1,100 l/s
Berdice pumping station	100 l/s
Bushat pumping station	2 l/s
Bacallek pumping station	100 l/s
Dajc pumping station	11 l/s
Oblike pumping station	2 l/s
Other wells	80-100 l/s

Nenshkoder-Zadrime area

For the Nenshkoder and Zadrime area, the discharges of wells and pumping stations are presented. Approximately 800-1000 l/s are taken from the Nenshkoder plain, while about 300 l/s are taken from the Zadrime area together with the surrounding springs. The total given for these sectors reaches about 900 l/s.

Table 6 - Discharges of wells and pumping stations in Nenshkoder-Zadrime.

Area	Well discharges (l/s)	Station discharges (l/s)	Total (l/s)
Samrisht-Dajc-Shkoder	200	6	206
Trush-Velipoje	200	200	400
Barbullush-Bushat, Mabe	75	12	87
Zojs-Gjader-Gramsh Lezhe	30	16	46
Blinisht-Piraj	20	16	36
Torovice	12	12	24
Kakariq-Gocaj-Balldre	20	5	25
Total			824

Carbonate areas

Table 7 - Exploitation in carbonate areas.

Area	Spring / springs	Exploited discharge
Tropoja	Quku i Dunishes and Selimaj	100 l/s
Pogradec	Tushemisht-Burimas	300 l/s
Pogradec / Lin	Lini Spring	120 l/s
Kukes	Gurra e Kolosianit and the Lojme springs	200 l/s
Kruma	Gurra e Krumes	100 l/s
Peshkopia	Radomira springs	100 l/s

The total quantity used in the Drin Basin is about 2,900-3,000 l/s, of which about 2,100 l/s come from Quaternary deposits and about 800 l/s from carbonate water-bearing complexes.

5.4.3 Hydraulic indicators and exploitation coefficient by water-bearing complexes

The exploitation coefficient (K), the exploited discharge (Q) and the hydraulic indicators are basic elements for the quantitative characterization of water-bearing complexes and for their translation into groundwater bodies (GWB). Lithological or qualitative description alone is not sufficient to assess the real capacity, the pressure from exploitation and the need for monitoring.

Table 8 - Quantitative and hydraulic indicators of water-bearing complexes in the Drin Basin.

Water-bearing complex / area	Q groundwater use	K exploitation	Hydraulic indicators in the report	Technical assessment
Shkodra alluvial-Quaternary	1,200-1,300 l/s	0.33-0.5	Dobrac: maximum thickness of Quaternary deposits up to 86 m; high filtration properties; automatic monitoring with amplitude about 3 m, temperature 14.6-16.62 °C and conductivity 250-410 µS/cm. q, k and T are not given numerically.	High water-bearing potential and strategic role for Shkodra; K indicates moderate exploitation, but expanded monitoring is required.
Nenshkoder-Zadrime alluvial-Quaternary	900-1,000 l/s; the table gives 824 l/s for grouped discharges	about 0.5	Discharges of wells and stations are given by sectors. q, k and T are not given numerically.	Very important supply unit; comparable hydraulic indicators should be completed.

Water-bearing complex / area	Q groundwater use	K exploitation	Hydraulic indicators in the report	Technical assessment
Carbonate: Tropoja	100 l/s	Not given	Quku i Dunishes and Selimaj. Complete data on discharge regime, q, k or T are not given.	Springs of local/regional importance; systematic discharge monitoring and K assessment are required.
Carbonate: Pogradec-Tushemisht-Lin	420 l/s: Tushemisht about 300 l/s; Lin about 120 l/s	Not given	Carbonate springs with considerable discharge. Full hydraulic indicators for the water balance are not given.	Strategic complex for supply and GWB; requires a separate quantitative balance.
Carbonate: Kukes	about 200 l/s	Not given	Gurra e Kolosianit and the Lojme springs. Hydraulic indicators are not presented in a systematic form.	Important springs; regular monitoring of discharge and seasonal trend is required.
Carbonate: Kruma	about 100 l/s	Not given	Gurra e Krumes. Complete hydraulic indicators are not given.	Strategic local spring; indicators for quantitative pressure and discharge stability are missing.
Carbonate: Peshkopia / Radomira	about 100 l/s	Not given	Radomira springs. K is not given and there is no separate table of hydraulic parameters.	Supply-important springs; documentation of the discharge regime is required.
Total of the Drin Basin	2,900-3,000 l/s	-	About 2,100 l/s from Quaternary deposits and about 800 l/s from carbonate complexes.	High supply potential, but hydraulic characterization is not complete for all units.

In the Drin Basin, the exploitation coefficient is clearly given for the Shkodra alluvial-Quaternary water-bearing complex and for the Nenshkoder-Zadrime area, but the same level of detail is not provided for the carbonate springs of Tropoja, Pogradec, Kukes, Kruma and Peshkopia. For these springs, mainly exploited discharges are given, while exploitation coefficients and comparable hydraulic indicators such as q, k and T are missing.

This limitation has been taken into account in the characterization of the GWBs, because the determination of quantitative status requires linking the exploited discharge with resources, seasonal level or discharge regime, hydraulic parameters and monitoring network density.

5.5 Flood occurrence and flood risk in the Drin-Buna River Basin

Flood frequency analysis for individual water bodies was performed using standard methods, fitting annual maximum daily flows to probability distributions to estimate return-period discharges for T = 2, 5, 10, 25, 50, 100, 200, 500, and 1,000 years. These estimates support compliance with the EU Floods Directive (2007/60/EC) and the design of hydraulic infrastructure. Details can be found in the Task Report 9.

Flooding is a major water management risk in the Drin-Buna River Basin. The lower basin around Shkodër, Lake Shkodra, the lower Drin and the Buna floodplain is particularly exposed because several flood mechanisms coincide: high Drin discharges from the mountain catchments, high inflows from the Kir and Gjadër rivers, high Lake Shkodra levels, limited conveyance capacity of the Buna River, low-gradient floodplain topography, backwater effects, coastal water levels and the operation of the Drin hydropower cascade. The Flood Risk Management Plan Shkodër regio⁴³ describes flooding in the Drin-

⁴³ Flood Risk Management Plan Shkodër Regio (2022), prepared in the frame of the project: Adaptation Climate Change through Transboundary Flood Risk Management in Western Balkans implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of German Federal Ministry for Economic Cooperation and Development (BMZ).

Buna Lowland as a regular natural phenomenon caused by winter rainfall, snowmelt and limited discharge capacity, and identifies the interaction between rivers, lake, wetlands and groundwater as a key factor in flood behaviour.

Under the EU Floods Directive, flood risk management should be based on preliminary flood risk assessment, flood hazard and risk maps, and flood risk management plans. Flood hazard maps show areas that may be flooded, while flood risk maps show the potential adverse consequences for population, economic activity, environment and cultural heritage.

The flood record shows a clear pattern. The Drin cascade provides substantial flood attenuation in most years, but during extreme events, particularly when the Fierza reservoir is already near capacity, spillway activation at Vau i Dejës can produce very high outflows that propagate directly into the lower Drin and Buna system. The 2022 event, during which total outflow at Vau i Dejës reached 2,441 m³/s, of which 1,389 m³/s passed through the spillway, ranks among the most significant releases on record based on the operational cascade data used for this RBMP. This remains below the reported Vau i Dejës spillway capacity of 3,900 m³/s, indicating that the infrastructure retained a substantial safety margin, but the downstream consequences of such releases are severe for Shkodër and the low-lying Buna floodplain.

The years 2019 and 2023 stand out in the operational record as years with zero spillway activation at Vau i Dejës, corresponding to the driest inflow years in the dataset, with Fierza inflow maxima of only 690 m³/s and 1,177 m³/s, respectively. In these years, all inflow was routed through turbines, achieving full turbine use for energy production but suppressing the downstream natural flood pulse that aquatic and riparian ecosystems may require. This illustrates a key RBMP challenge: in dry years the cascade can strongly reduce natural hydrological variability, while in wet years emergency or coordinated spillway releases can contribute to downstream flood peaks. Environmental flow requirements, flood routing rules and hydropower operation should therefore be assessed jointly.

Table 9 - Indicative overview of significant floods in recent decades.

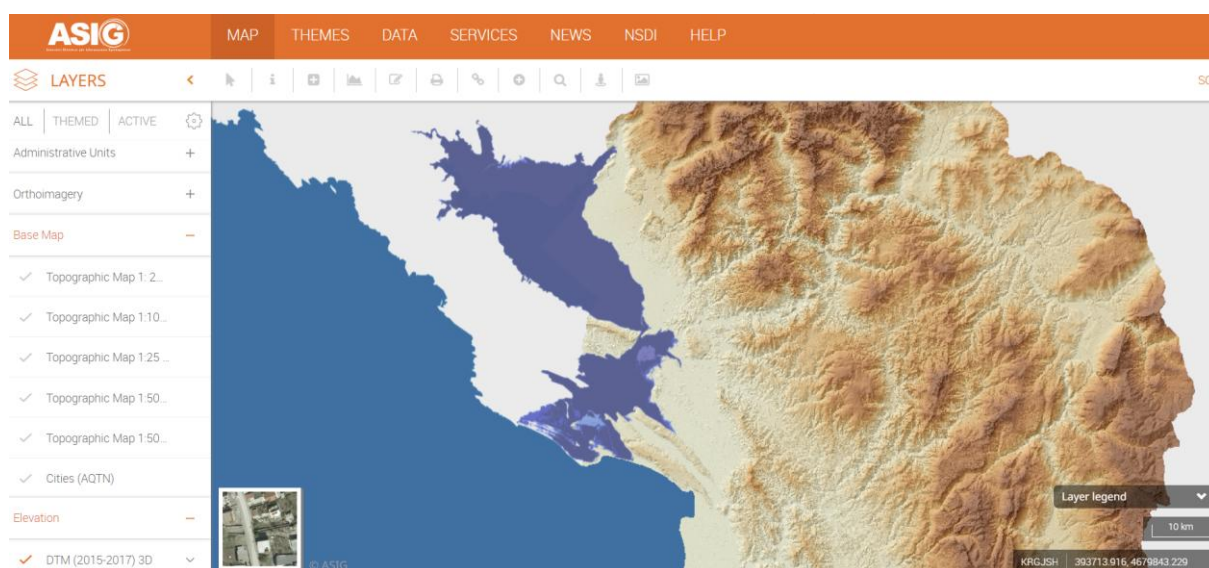
Year / period	Main characteristics and reported impacts
2003/2004	Identified in the Shkodër FRMP flood-history timeline and by the JRC/Copernicus flood-risk activation as a relevant historical flood event affecting the Drin/Buna–Shkodër area.
January 2010	Major flood in Shkodër and Lezhë. The water load on the Buna was estimated at approximately 3,600 m ³ /s, including about 3,000 m ³ /s from the Drin, mainly related to snowmelt in the Drin Basin. IFRC reported flooding in Shkodër and Lezhë, with thousands of people evacuated.
December 2010	Extreme flood event. The Shkodër region received about 900 mm rainfall from mid-November to mid-December, Lake Shkodra reached its maximum historic recorded level, and the water load on the Buna exceeded 4,000 m ³ /s. About 12,145 inhabitants were affected or evacuated and about 7,120 houses were affected, including flooded houses and houses surrounded by water.
2013	Further flood impacts occurred after the 2010 events. The FRMP notes that emergency embankment and dike interventions after January 2010 were partly damaged again during the December 2010 extreme event and later in 2013.
March 2018	Heavy rainfall and snowmelt caused flooding in northern Albania; Shkodër County was reported as the worst affected area, with the Drin and Bojana/Buna rivers overflowing. Reports also referred to controlled hydropower discharges during the event.
January–February 2021	Flooding affected villages along the Buna, including Dajç, Shirq and Obot, and parts of Shkodër. By 11 February, the Ministry of Defence reported about 5,030 ha flooded in Shkodër County.
November 2022	Heavy rainfall caused flooding, landslides and damage in Shkodër and Lezhë counties. Reuters reported that KESH had to discharge more water to keep dams safe, while FloodList ⁴⁴ reported damaged homes, roads, infrastructure and flooded farmland. The RBMP operational record identifies this as a major Vau i Dejës release event.

For the RBMP, flood risk management should not be treated only as a protection issue only. It directly affects hydromorphology, sediment transport, floodplain connectivity, wetland functioning, water quality

⁴⁴ <https://floodlist.com/>

and ecological resilience. Measures should therefore combine structural safety where needed with WFD-compatible solutions.

Flood hazard and risk mapping has progressed under Albania's alignment with the EU Floods Directive. The Floods Directive requires a preliminary flood risk assessment, flood hazard maps, flood risk maps, and Flood Risk Management Plans (FRMP), with hazard maps showing inundation areas and risk maps showing potential adverse consequences for people, the environment, cultural heritage, and economic activity. Under the PRO NEWS process⁴⁵, Albania identified Areas of Potential Significant Flood Risk (APSFRs) and developed flood hazard maps for high-risk river stretches, including the Drin-Buna, using high-resolution terrain data, field surveys, bridge reconstruction, meteorological data, and hydraulic modelling. ASIG⁴⁶ now provides flood hazard and risk layers for the Drin-Buna Basin through the national geoportal, including water depth and flow velocity layers for different return-period scenarios.



Map 2 - Flood-prone areas in the Drin-Buna basin⁴⁷

The RBMP integrates the findings based on the work done developing the Albania FRMPs, covering Erzen, Ishëm, Shkumbin, Seman, Drin-Buna and Vjosa, with 36 areas of potential significant flood risk (APSFR), hydrological and hydraulic models, flood zone mapping, risk maps, damage estimation, feasibility studies, cost-benefit analysis and an FRMP for each river basin⁴⁸.

In summary, the Drin-cascade provides substantial flood attenuation in most years, but during extreme events, particularly when Fierza reservoir is near capacity, spillway activation at Vau i Dejës can produce very high outflows. Coordinated spillway management protocols and downstream early warning systems are essential components of the flood risk management plan. Conversely, in dry years (e.g. 2019, 2023), zero spillway activation and 100% turbine utilisation suppress all natural flood variability, potentially depriving downstream ecosystems of ecologically necessary high-flow events.

⁴⁵ CIMA/PRO NEWS reports that Albania's flood hazard mapping identified APSFRs and produced hazard maps for high-risk stretches of the Ishëm, Erzen, Drin-Buna, Shkumbin and Vjosa rivers, based on high-resolution DEMs, field surveys, bridge reconstruction, meteorological data and hydraulic modelling - CIMA Research Foundation.

⁴⁶ ASIG Geoportal metadata shows flood hazard/risk layers, including depth and velocity information for return-period scenarios, developed in line with the EU Floods Directive.

⁴⁷ <https://geoportal.asig.gov.al/map/?auto=true>.

⁴⁸ <https://www.typpsa.com/en/projects/flood-risk-management-plans-in-albania/>

5.6 Drought occurrence and water scarcity in the Drin-Buna River Basin

Drought and water scarcity are increasingly relevant for the Drin-Buna River Basin, even though the basin is generally one of the most water-rich systems in Albania. In WFD terms, drought should be understood as a temporary reduction in average water availability, while water scarcity refers to a structural or recurring imbalance between sustainable water availability and water demand. The WFD provides the planning framework to address both issues through sustainable water use, long-term protection of available resources, environmental flow requirements, groundwater protection and, where necessary, drought management measures within the RBMP.

The Drin-Buna system is particularly sensitive to drought because water availability supports several interdependent uses: hydropower generation in the Drin cascade, irrigation in agricultural areas, drinking water supply, groundwater recharge, lake and wetland ecology, fisheries, tourism and dilution capacity for pollution loads. Albania's energy system is especially exposed: more than 95% of national electricity capacity is hydropower-based, and approximately 90% of generation is linked to the River Drin system. Low rainfall years therefore directly affect both water management and national energy security. In 2017, a low-rainfall year forced Albania to import nearly 40% of its electricity, at an estimated cost of USD 240 million.

The drought analysis for this RBMP shows a nuanced but important signal. The precipitation-based SPI indicator (see textbox) does not show a clear trend, indicating that rainfall inputs remain broadly stationary over the 43-year record. However, the temperature-sensitive SPEI (see textbox) shows a marginally declining tendency. This is significant because SPEI includes both precipitation and potential evapotranspiration and therefore captures the effect of rising temperatures on water demand and atmospheric drying. The two most severe droughts in the full 43-year record occurred in the most recent decade: 2017–2018, and 2022. This clustering suggests that warming is increasingly amplifying drought severity even where precipitation trends remain weak or statistically insignificant. More details can be found in the Task Report 9.

SPI – Standardized Precipitation Index

*SPI is a drought indicator based only on **precipitation**. It shows whether a period was wetter or drier than normal compared with the long-term average. A negative SPI means dry conditions; a positive SPI means wet conditions. SPI is useful to detect rainfall deficits, but it does **not** include temperature or evaporation.*

SPEI – Standardized Precipitation Evapotranspiration Index

*SPEI is similar to SPI, but it also includes the effect of **temperature and evapotranspiration**. It compares precipitation with the atmospheric water demand. When temperatures rise, evaporation increases, and soils, rivers and reservoirs can become drier even if rainfall does not change much. SPEI is therefore better suited to assess drought under climate change.*

Table 10 - Indicative overview of recent drought and dry-period events.

Period / year	Main characteristics and relevance for the Drin-Buna RBMP
2005 and earlier dry years	Severe droughts affected Albania's hydropower-dependent electricity system and contributed to power cuts, illustrating the systemic sensitivity of water-dependent energy production ⁴⁹ .
2017–2018	Most severe multi-year drought in the RBMP 43-year analysis until 2022. The 2017 drought had major national energy consequences because low rainfall reduced hydropower production and required substantial electricity imports.
2019	Very dry hydrological year in the Drin cascade operational record, with no spillway activation at Vau i Dejës and full routing of inflow through turbines. This supported energy production but reduced downstream hydrological variability.

⁴⁹ <https://wiiw.ac.at/albania-periodic-evils-dlp-410.pdf>

2022	Most severe drought in the RBMP 43-year record. The wider European 2022 drought was driven by persistent precipitation deficit, high temperatures and heatwaves, affecting agriculture, energy and river systems (Copernicus Climate Change Service). In Albania, lack of rainfall and overuse of water reserves contributed to energy-sector stress.
2023	Dry operational year in the cascade record, again with no spillway activation at Vau i Dejës. This confirms that recent dry years can fully suppress natural flood pulses downstream.
2025	A severe Western Balkans drought and heatwave affected Albania and Kosovo, with scarce rainfall, low river levels, agricultural stress and reduced hydropower production; Albania's power corporation spent up to EUR 60 million on imports in the first half of the year.

For operational drought management, the RBMP should draw three conclusions. First, drought monitoring should use SPEI in addition to SPI indicators, because SPI alone can underestimate drought severity in a warming climate. Second, drought contingency planning should assume that future droughts may be more severe than historical rainfall records suggest, because higher temperatures amplify every dry spell through increased evapotranspiration. Third, the concentration of the most severe droughts in the recent decade indicates that the basin may be moving towards a new drought regime with shorter recurrence intervals for severe events. Climate projections for the Drin Basin also indicate increasing frequency and intensity of droughts, water scarcity, stronger summer heat, lower summer precipitation and cascading impacts on agriculture, hydropower, ecosystems and society⁵⁰.

Albania's national water and disaster-risk policies recognise drought and water scarcity as strategic risks. The National Strategy for Integrated Water Resources Management includes disaster risk reduction and management for drought and floods, while the National DRR Strategy foresees drought risk assessment and stronger early warning systems^{51 52}.

5.7 Global Climate Change and Impacts for Albania

5.7.1 Current state and projections

The latest assessments confirm rapid warming across Europe, fastest of all continents, with the Mediterranean sub-region, which includes Albania, projected to experience hotter, drier summers, wetter winters, and more frequent extremes (heatwaves, droughts, intense rainfall) as warming increases. Europe's first Climate Risk Assessment identifies water resources, energy, food systems, ecosystems/biodiversity, and infrastructure as high-priority risk clusters already reaching critical levels in parts of Southern Europe^{53 54}.

Temperature

Albania is expected to warm substantially this century under all emissions pathways. IPCC's AR6 regional material for Europe reports continued increases in mean temperature and heat extremes, with the Mediterranean showing strong summer warming and longer, more intense heatwaves; these trends intensify with higher global warming levels⁵⁵. Albania's Revised Nationally Determined Contribution⁵⁶ (NDC, 2021) projects an increase in mean annual temperature of +1.3 to +2.2 °C by 2050, and +1.2 to +4.4 °C by 2100 relative to 1986–2005. Summer warming is strongest, with maximum temperatures on the coast projected to rise by +1.5 °C (RCP2.6) to +6.4 °C (RCP8.5) by 2100, accompanied by many more tropical nights and longer warm spells.

⁵⁰ <https://www.adaptation-undp.org/projects/integrated-climate-resilient-transboundary-flood-risk-management-drin-river-basin-western>

⁵¹ Albania's National Strategy for Integrated Water Resources Management includes disaster risk reduction and management for drought and floods among its strategic objectives - https://eu4green.eu/wp-content/uploads/2025/02/Study-on-Climate-Change-Adaptation_Volume-I.pdf.

⁵² Albania's National DRR Strategy includes drought risk assessment and strengthening of early warning systems as strategic actions - https://www.undp.org/sites/g/files/zskgke326/files/2024-01/national_drr_strategy.pdf.

⁵³ European Environment, A., European Climate Risk Assessment. 2024, European Environment Agency.

⁵⁴ Horizon Europe, N.C.P.P., European Climate Risk Assessment - Executive summary. 2024, Horizon Europe NCP Portal.

⁵⁵ IPCC, Regional fact sheet - Europe. 2022, Intergovernmental Panel on Climate Change.

⁵⁶ Albania's Revised Nationally Determined Contribution (NDC), 2021 - <https://unfccc.int/sites/default/files/2022-08/Albania%20Revised%20NDC.pdf>.

Precipitation

Projections indicate a seasonal redistribution of precipitation; decreases in summer precipitation and increases in heavy precipitation events (especially cool-season) are likely for the Mediterranean, heightening both drought risk (in summer) and flood hazard (from short-duration extremes). Mean annual precipitation is projected to decline by –2% to –4% by 2050 and by up to –12% by 2100 in a high-emissions scenario. The most robust signal is a marked summer drying trend, particularly in southern Albania, with drought indices like the Standardised Precipitation–Evapotranspiration Index SPEI showing a worsening water balance throughout the century.

Sea level rise (SLR)

Global mean sea level has risen ~21 cm since 1900 and reached a record in 2023; by 2100, it is likely to rise ~0.28–0.55 m (very low emissions) to ~0.63–1.02 m (very high emissions), with local variations for the Adriatic/Mediterranean. Such changes will result in more frequent extreme sea levels and increased risk of coastal inundation and erosion⁵⁷. For the Adriatic specifically, recent studies highlight steric (thermal) expansion as a dominant driver to mid-century, with local vertical land motion modulating relative SLR at the coast⁵⁸.

Observed and extreme events in the Western Balkans

In summer 2025, the Western Balkans, including Albania experienced severe drought and heat (up to ~40 °C in Albania), drying rivers, constraining irrigation and hydropower, and prompting energy imports, consistent with the expected rise in compound heat-drought events⁵⁹. Europe also saw its most widespread river flooding in over a decade in 2024, underscoring the increasing volatility of the hydrologic cycle⁶⁰. Heatwaves are projected to intensify, while signals for heavy precipitation remain mixed. However, risks such as short-duration storms, urban pluvial flooding and flash floods in steep catchments are expected to remain significant even with declining summer averages. Fire weather conditions will also become more frequent and severe at ≥ 2 °C of global warming.

5.7.2 Expected implications for Albania: focus on the Drin-Buna basin

Climate change is expected to affect the Drin-Buna River Basin through changes in water availability, more frequent and severe floods and droughts, increased pressure on the hydropower-dominated energy system, impacts on agriculture and irrigation demand, risks to low-lying coastal and floodplain areas, and growing pressure on aquatic, riparian and wetland ecosystems.

Water resources, floods and droughts

Hotter and drier summers, combined with higher evaporation, are expected to intensify hydrological droughts, low flows and seasonal water scarcity in the basin. At the same time, more intense rainfall events may increase flash-flood and river-flood risk, particularly in steep mountain catchments and in the lower Drin-Buna floodplain. The lower basin around Shkodra, Lake Shkodra, the Buna River and the Adriatic coastal zone is especially vulnerable because river discharge, lake levels, drainage capacity, backwater effects and coastal water levels interact in a complex way. These risks are prominent in EUCRA and IPCC regional findings for Southern Europe^{61 62}. Climate vulnerability profiles for Albania emphasize frequent floods, storms, and droughts as key hazards.

Energy sector

The Drin-Buna Basin is central to Albania's hydropower system. The Drin cascade provides a major share of national electricity generation and therefore links basin hydrology directly to energy security. This creates a low-carbon but climate-sensitive energy system. Drought years reduce inflows to the reservoirs and may force costly electricity imports, while wet years require careful reservoir operation to manage flood risk downstream^{63 64}. Recent dry and heat-stress events, including the 2025 heat-drought period, again showed the vulnerability of hydropower production to prolonged dry spells. For the RBMP,

⁵⁷ World Climate Research, P., New high-end estimate of sea-level rise projections. 2022, WCRP (wcrp-climate.org).

⁵⁸ Verri, G., Climate projections of the Adriatic Sea: role of river release. *Frontiers*, 2024.

⁵⁹ Associated, P., Western Balkans region faces severe drought and water restrictions during heat wave. 2025, AP News.

⁶⁰ Reuters, Europe had most widespread floods for more than a decade in 2024, scientists say. 2025, Reuters.

⁶¹ European Environment, A., *European Climate Risk Assessment*. 2024, European Environment Agency.

⁶² IPCC, *Regional fact sheet - Europe*. 2022, Intergovernmental Panel on Climate Change.

⁶³ Emissions Trading, E., THE WESTERN BALKAN POWER SECTOR. 2022, Emissions Trading Extra.

⁶⁴ Balkan Green Energy, N., Albania forced to import 80 percent of electricity due to. 2017, Balkan Green Energy News.

this underlines the need to align reservoir operation, environmental flow requirements, flood management and drought preparedness.

Agriculture and water demand

Higher temperatures, more frequent heat extremes and summer rainfall deficits are expected to increase irrigation demand and water stress in agricultural areas of the Drin-Buna Basin, particularly in the lowlands and floodplain areas around Shkodra, Lezhë and the lower Buna system. Rain-fed crops may become more vulnerable to dry periods, while irrigated agriculture may increase pressure on surface water and groundwater resources.

Coasts, wetlands and sea-level rise (SLR)

The low-lying Adriatic coastal zone of the Drin-Buna Basin, including the Buna mouth, Velipojë, the Viluni lagoon and associated wetlands, is vulnerable to sea-level rise, storm surges, coastal inundation, erosion and salinisation. Changes in sediment supply, river discharge and coastal dynamics may further affect shoreline stability and wetland functioning. These processes may influence transitional and coastal water bodies, groundwater salinity, agricultural land quality and the conservation value of protected coastal habitats.

Biodiversity & ecosystems

MedECC and EUCRA flag accelerating risks to Mediterranean biodiversity from warming, drought, wildfire, invasive species, and coastal degradation. The Mediterranean hotspot status implies high risks for ecosystems. Sensitive ecosystems include mountain streams, karst springs, Lake Ohrid, Lake Shkodra, riparian corridors, floodplain wetlands, lagoons and the Buna delta. Albania's conservation steps, such as declaring the Vjosa River a National Park, support resilience but will need to be paired with basin-scale adaptation to changing hydrology⁶⁵.

5.7.3 National strategies, commitments, and alignment with EU policy

In its pursuit of a resilient and sustainable future, Albania has progressively aligned its national climate policies with EU frameworks and global climate governance. Through strengthened commitments, updated legislative instruments, and strategic planning across sectors, the country is seeking to translate these goals into coherent action. There is a need to coordinate national action with regional alignment, which is important not only for meeting greenhouse gas reduction targets, but also for ensuring adaptive capacity across vulnerable communities and ecosystems.

To embed this commitment in law, *Law No. 155/2020 on Climate Change* establishes a national legal framework fully in line with EU regulations, providing a backbone for climate governance. Complementing this is the *National Climate Change Strategy (2019)* and the *National Adaptation Plan (NAP)* process, which together steer cross-sectoral adaptation planning across water, agriculture, energy, infrastructure, health, and ecosystems.

Supporting these instruments are several sectoral and reporting mechanisms. The *Fourth National Communication (2022)* delivers updated vulnerability and adaptation assessments in areas such as water resources, agriculture, biodiversity, forestry, soils, public health, disaster risk reduction, tourism, and human settlements. Meanwhile, the *National Energy and Climate Plan (NECP, 2021)* articulate Albania's pathways toward 2030 by having a mitigation ambition the level 20.9% below business-as-usual emissions by 2030, expanded coverage to all main sectors, and set priority adaptation measures for coasts, agriculture, forestry and land use with a focus on energy security⁶⁶. The *Fourth National Communication (2022)* presents updated vulnerability and adaptation assessments for water, agriculture, biodiversity, forestry, soils, health, disaster risk reduction, tourism, and settlements⁶⁷.

⁶⁵ MedECC: Mediterranean Experts on Climate and environmental Change - Homepage. 2024, MedECC.

⁶⁶ UNFCCC, Nationally Determined Contributions Registry. 2024, United Nations Framework Convention on Climate Change (UNFCCC).

⁶⁷ Ministry of, T., Environment, N.A.P.G. Network, and Undp, Albania's National Adaptation Plan: First progress report. 2023, NAP Global Network / Government of Albania.

Table 11 - Projected Climate Changes for Albania (IPCC AR6 / MedECC / EEA).

Variable	Historical (1981–2010)	Mid-Century (2041–2070)	End-Century (2071–2100)	Notes
Mean annual temperature	~12–13 °C	+1.5 to +2.5 °C	+3.5 to +5 °C	Strongest warming in summer
Summer precipitation	130 mm	–10 to –20 %	–15 to –30 %	Dry season deficits intensify
Heavy rainfall events	Baseline	+10 to +30 % freq.	+20 to +40 % freq.	More flash-flood risk
Sea level rise (Adriatic)	+21 cm since 1900	+0.28–0.55 m	+0.63–1.02 m	Higher if ice-sheet instability

5.8 Water Use and Water Infrastructure

5.8.1 Overview and Summary of Water Services

Water resources are one of the defining natural assets of the Drin–Buna River Basin, supporting domestic water supply, agriculture, hydropower generation, industry, fisheries, tourism and a wide range of ecosystem services. As defined under the EU WFD, water services include the abstraction, storage, treatment and distribution of water, together with the collection and treatment of wastewater.

The Drin–Buna Basin is distinguished by its exceptional hydrological importance within Albania. Besides supplying drinking water to urban and rural communities, the basin supports one of the country's most important hydropower systems, extensive irrigated agriculture in the lowlands and diverse economic activities associated with fisheries, tourism and manufacturing. At the same time, the basin contains internationally significant aquatic ecosystems, including Lake Shkodër, the Buna River and Lake Ohrid, whose ecological integrity depends on maintaining good quantitative and qualitative water status.

Water services are delivered through an extensive network of groundwater abstractions, springs, reservoirs, irrigation schemes, distribution networks, sewerage systems and wastewater treatment facilities operated by public water utilities and other water management institutions. Although considerable progress has been achieved through recent investments and sector reforms, important challenges remain, particularly regarding non-revenue water, ageing infrastructure, wastewater collection and treatment, service continuity in some municipalities and the long-term financial sustainability of water utilities.

Understanding the structure of water use within the basin is essential for assessing current pressures on water resources, evaluating future demand and identifying the most cost-effective measures for achieving the environmental objectives established under the River Basin Management Plan.

Among consumptive water uses, agriculture represents by far the largest water user, accounting for approximately 400 million m³/year of irrigation abstractions under current conditions. Public water supply represents a considerably smaller share, with annual water production of approximately 44 million m³, while industrial and livestock water use remain relatively limited. In contrast, hydropower generation constitutes the dominant non-consumptive water use, making the Drin–Buna Basin one of Albania's most strategically important river systems from both water management and energy perspectives.

5.8.2 Drinking Water Use and Supply from Surface and Groundwater

Drinking water supply represents one of the essential public services within the Drin–Buna River Basin, providing water to households, public institutions, commercial users and tourism facilities distributed across urban and rural municipalities. Water supply systems rely predominantly on groundwater resources and natural springs, which generally provide good-quality raw water requiring limited treatment before distribution.

Regional water utilities abstract water from springs, wells and groundwater bodies before delivering it through municipal distribution networks. Although service coverage has gradually improved following

the consolidation of utilities, important differences remain between municipalities in terms of continuity of supply, metering levels, operational efficiency and network performance.

Current annual water production across the basin is estimated at approximately 43.6 million m³, while only around 23 million m³ reaches final consumers, reflecting relatively high levels of non-revenue water in several utilities. Existing losses are mainly associated with ageing infrastructure, physical leakages, illegal connections and operational inefficiencies. The implementation of leakage reduction programmes, network rehabilitation, pressure management and improved metering therefore represents one of the principal priorities for improving the performance and financial sustainability of water supply services.

Groundwater remains the strategic source of drinking water throughout most of the basin and will continue to play a central role in ensuring reliable water supply under future climate conditions. Protecting groundwater bodies from pollution and over-abstraction, while simultaneously improving distribution efficiency, will therefore remain fundamental objectives of future water management.

5.8.3 Industrial Water Use and Supply from Surface and Groundwater

Industrial water use within the Drin–Buna River Basin remains modest compared with agricultural abstractions but contributes significantly to regional economic development. The basin supports a diversified industrial base, including food processing, construction materials, mining, manufacturing and other processing industries, concentrated mainly around Shkodër, Lezhë, Kukës, Dibër and Pogradec. Industrial water is supplied through both municipal water supply systems and direct abstractions from groundwater, depending on the location, scale and specific production requirements of individual facilities. Groundwater continues to represent the preferred source for many industrial users because of its reliability and generally good water quality.

Although industrial abstractions account for only a small proportion of total basin water use, industrial activities may generate localised pressures on surface water and groundwater quality through wastewater discharges, historical contamination and diffuse pollution associated with former mining and industrial sites. Continued improvements in industrial wastewater treatment, environmental permitting, monitoring and cleaner production technologies will therefore be important for reducing environmental pressures while supporting sustainable economic growth.

5.8.4 Agricultural Water Use and Supply from Surface and Groundwater

Agriculture is by far the largest consumptive water user in the Drin–Buna River Basin and remains one of the most important economic sectors across the predominantly rural catchment. Irrigated crop production, livestock farming and horticulture support rural livelihoods and contribute significantly to regional food production.

Agricultural water is supplied primarily from surface water resources through reservoirs, rivers, diversion structures and irrigation canals, while groundwater provides an additional source during periods of reduced surface water availability or in areas where irrigation infrastructure is less developed. The basin contains approximately 95,000 ha of cultivated land, of which around 52,000 ha are currently irrigated (55% of the cultivated land), generating an estimated irrigation demand of approximately 400 million m³ per year under present conditions.

The existing irrigation infrastructure provides the foundation for agricultural production but requires continued rehabilitation and modernization to improve operational efficiency and reduce conveyance losses. Future climate change, increasing drought frequency and growing competition for water resources are expected to increase the importance of efficient irrigation scheduling, modern irrigation technologies and integrated water allocation.

Livestock production also depends on reliable water availability, although its overall demand remains relatively small compared with irrigation. Current livestock water demand is estimated at approximately 3 million m³/year, representing less than 1% of total agricultural water use.

Given the dominant role of irrigation within the basin's consumptive water use, improvements in irrigation efficiency, modernization of water distribution systems, rehabilitation of existing infrastructure and the

wider adoption of water-saving technologies offer the greatest opportunity for reducing future pressures on water resources while maintaining agricultural productivity and strengthening climate resilience.

5.8.5 Irrigation and Drainage Systems

Irrigated agriculture in Albania

Albania's agricultural sector is a key pillar of its rural economy, contributing approximately 21% to employment and around 18% to GDP⁶⁸ (including agro processing), which is approximately USD 5.3 billion (2025). Given the country's Mediterranean climate and seasonal rainfall, irrigation is essential for ensuring stable and productive agriculture, particularly in the fertile lowland and coastal plains. However, Albania's irrigation infrastructure has suffered from years of underinvestment and institutional reform.

Historically, Albania had one of the most extensive irrigation networks in the Balkans. At its peak in the 1980s, the country had approximately 435,000 hectares of irrigable land. However, after the transition from a centrally planned economy in the early 1990s, much of the infrastructure deteriorated. Today, Albania has an estimated 320,000 hectares of irrigable land, of which only approximately 140,000 hectares are regularly irrigated. The irrigation systems are typically classified into three categories:

- *Gravity-fed systems*: these dominate the landscape and are based on diversion from rivers and streams via weirs and canal distribution systems. Examples include the systems in the Myzeqe plain (around Fier) located in the downstream part of the Seman and Vjose river basins, the upstream part of the Seman river basin and the Drin river basin.
- *Pumping systems*: Located mainly in coastal and low-lying areas where water must be lifted, such as in parts of the regions of Fier, Lezhë, and Durres.
- *Reservoir-based systems*: Supplied by small and medium-sized reservoirs (over 640 nationwide), primarily in hilly or mountainous areas. These systems help regulate seasonal flows but often suffer from sedimentation and lack of maintenance.

Albania has invested substantially in rehabilitation and modernisation of irrigation and drainage systems. Nationally, more than 183,000 ha of irrigation and drainage systems and 44 dams have been rehabilitated, while the Water Resources and Irrigation Project improved 40,000 ha of irrigation and drainage services, rehabilitated 13 dams, and supported an Irrigation and Drainage Management Information System for agriculturally intensive municipalities⁶⁹ ⁷⁰. Several investments under this programme were located in the Drin-Buna and Seman River Basins, including schemes in agricultural districts such as Lezhë, Berat and Fier.

Since 2015–2016, Albania has decentralised much of the operation and maintenance of irrigation and drainage infrastructure to municipalities and municipal Irrigation and Drainage Units:

- Municipalities: Since the 2015 administrative reform, municipalities are legally responsible for the operation and maintenance of primary and secondary irrigation and drainage systems within their authority. However, their technical and financial capacity is often limited.
- Water Drainage Boards (WDBs): Reforms in December 2015 consolidated 13 previous irrigation and drainage boards into four Regional Drainage Boards, each covering major agricultural lowland areas: Lezhë, Durres, Fier and Korçë. These are regional public bodies tasked with managing large-scale drainage infrastructure and some primary irrigation canals, especially in agriculturally important lowland areas like Fier and Vlora. The WDB of Fier, for example, plays a key role in maintaining the functionality of the vast drainage and irrigation network in the Myzeqe plain, one of Albania's most productive agricultural areas.

The table below provides an overview of key irrigation systems across Albania, highlighting the type of system, the command area in hectares, and the average flow rate during the peak irrigation season (in cubic meters per second).

⁶⁸ GDP of Albania: USD 29.27 billion (nominal, 2025), World Economic Outlook Database, October 2024 and International Monetary Fund, March 2025.

⁶⁹ <https://ewdata.rightsindevelopment.org/files/documents/86/WB-P162786.pdf>

⁷⁰ <https://documents1.worldbank.org/curated/en/099164002202339212/pdf/P1787150025b3e080b06a05a4e240dc694.pdf>

Table 12 - Overview of key irrigation systems across Albania.

Irrigation System / Region	Irrigation Type	Command Area (ha) regularly irrigated	Average Flow Rate in Peak Season (m ³ /s)
Myzeqe Plain (Fier)	Gravity-fed (main canals + pumping)	80,000	22.5
Drin Basin (Shkodra / Lezhë / Dibër / Bulqizë)	Gravity-fed + pumping	25,000	7.2
Seman Basin (Berat/Kuçova)	Gravity-fed from reservoirs	18,000	4.8
Korça Plateau	Reservoir-based (gravity)	12,000	3.1
Vjosa Delta (Vlora)	Pumping & gravity (mixed)	10,000	2.5
Durres Coastal Area	Pumping (lowland/coastal)	8,000	2.0
Devoll Valley	Reservoir-fed (mountain runoff)	7,000	1.8
Lushnja Hills Reservoir Systems	Reservoir-fed (seasonal creeks)	5,000	1.2

Irrigation supports a wide range of crops in Albania, with variations across regions:

- Field crops: Such as wheat, maize, and barley are irrigated to improve yields, especially during dry spring periods.
- Vegetables: Including tomatoes, peppers, cucumbers, and onions, mostly grown in the western plains and under greenhouse conditions.
- Fruit orchards: Such as apples, plums, and citrus require supplementary irrigation, especially in the summer months.
- Vineyards and olives: Increasingly irrigated to boost quality and resilience to climate change.

High-value crops like greenhouse vegetables and fruits are becoming more dominant in irrigated areas, driven by market demand and export potential.

Irrigation & Drainage in the Drin-Buna Basin

The main irrigation sources in the basin are irrigation reservoirs, rivers and groundwater abstraction through pumping stations. Irrigation is mainly provided through open canals and furrow irrigation, using secondary and tertiary distribution networks. Drainage is especially important in the lower Drin-Buna system, where agriculture is exposed to high groundwater levels, floodwater, poor natural drainage and backwater effects from the Drin, Lake Shkodra and the Buna River. The drainage network covers about 60,000 ha, mainly in Shkodër–Malësi e Madhe and Lezhë, with a much smaller drained area in Kukës–Has–Tropojë. The basin includes about 1,400 km of main drainage canals, while drainage pumping stations are concentrated in Shkodër, Lezhë and Pogradec⁷¹.

The main irrigated crops in the Drin-Buna Basin are linked to the agricultural valleys and lowland production areas. In the wider extended Drin Basin, the main crops include wheat, maize, apples, plums and potatoes, with varying irrigation demand. In the Albanian Drin-Buna lowlands, irrigation is also important for vegetables, fruit trees, forage crops and maize, which generally have higher seasonal water demand during the dry summer period. These crop patterns make irrigation efficiency, reliable water allocation and monitoring of agricultural return flows relevant for the RBMP, particularly where abstraction pressure, nutrient losses and pesticide transport may affect surface water bodies, groundwater bodies and downstream wetlands⁷².

1.1.1 The Drini Cascade Hydropower System

The Drini Cascade is a system of three hydropower plants (HPPs) constructed in series on the Drin River in northern Albania, operated by KESH (Albanian Power Corporation). With a combined installed capacity of 1,350 MW and average annual generation of approximately 4,300 GWh, the cascade produces roughly 90% of Albania's total hydropower output and supplies more than 30% of the country's

⁷¹ First Drini-Buna Final River Basin Management Plan, June 2019.

⁷² DrinCorda, Transboundary Diagnostic Analysis - Thematic Report on the Resource NEXUS, 2019.

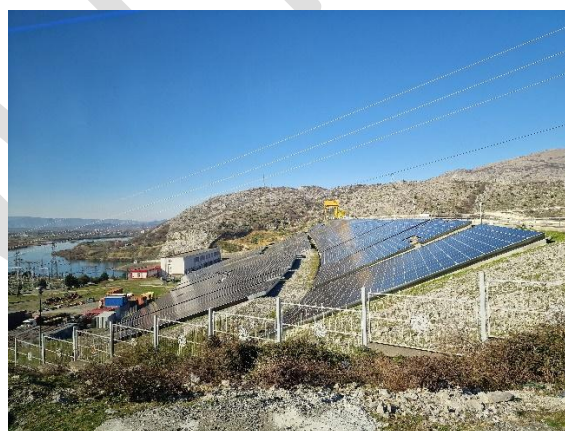
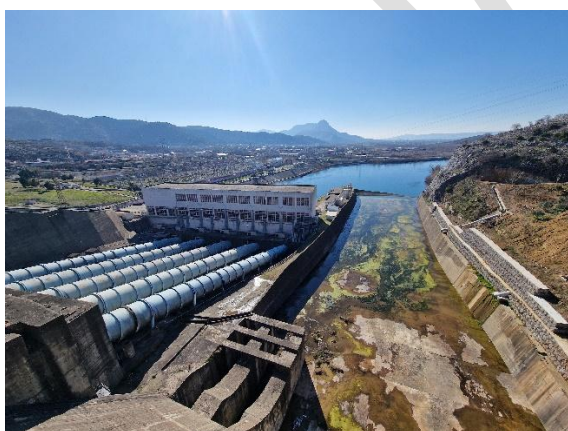
total electricity demand. It is described as unique in Europe due to the dam heights, dam types, the reservoirs they create, and the total installed capacity⁷³.

The inflows into the cascade are not fully natural as upstream dams exist in North Macedonia (Globočica, Špilje on the Crn Drim). The three HPPs in Albania, from upstream to downstream, are: HPP Fierza (500 MW, operational since 1978), the upstream regulating reservoir with the largest storage in Albania (2,700 Mm³ design volume); HPP Koman (600 MW, operational since 1985), the largest power plant functioning mainly as a re-regulating reservoir; and HPP Vau i Dejës (250 MW, operational since 1971), the most downstream plant whose outflow defines the regulated Drin discharge.

All three are classified as Risk Class I with approximately 196,000 people at risk in the event of dam failure.

Table 13 - Summary characteristics of the Drini Cascade hydropower system.

Parameter	Fierza	Koman	Vau i Dejës	Total
Installed capacity (MW)	500	600	250	1,350
Avg. generation (GWh)	~1,300	~1,800	~1,000	~4,300
Year operational	1978	1985	1971	—
Dam height (m)	166.5	115.5	54.0	—
Reservoir vol. (Mm ³)	2,700	500	580	3,780
Active vol. (Mm ³)	2,300	188	263	2,751
Catchment (km ²)	11,829	12,850	14,173	—
Design inflow (m ³ /s)	202	289	310	—
Turbines	4	4	5	13
Nominal head (m)	118	96	52	—
Spillway cap. (m ³ /s)	2,670	3,600	3,900	—



Vau i Dejës Dam and Hydroelectric Power Station on the Drin River. A 12.9 MW solar PV project developed adjacent to the dam, which supplies renewable energy to support the dam's operations and the Hydroelectric Power Station.

⁷³ Jovani, A., Thomai, Gj., Fortuzi, L. and Shaha, F. (2021). Main Dams in Albania. ALBCOLD, Tirana.

5.9 Summary Water Balance of the Drin-Buna River Basin

This paragraph presents the hydrological analysis (see also Task Report 9) of the Drin-Buna River Basin across five connected domains: the general hydrological setting, water body identification, the operational hydrology of the Drini Cascade, the flow regime of individual water bodies, and the basin-wide water balance under current and projected future climate conditions. Together, these analyses show a basin with abundant water resources, but also a basin that is increasingly exposed to the combined effects of climate change and intensive hydropower regulation. The following cross-cutting findings summarise the key messages for the Drin-Buna River Basin Management Plan.

1. **A basin with strong hydrological contrasts.** The Drin-Buna River Basin covers a wide hydrological gradient. In the Valbona headwaters, runoff coefficients reach 0.93 and specific discharge exceeds 64 l/s·km². In contrast, in the Drini i Bardhë, evapotranspiration consumes 54% of precipitation and the runoff coefficient falls to 0.46. This means that climate change impacts will not affect all parts of the basin in the same way. The high-altitude, high-runoff sub-basins are more resilient, with a projected worst-case runoff decline of –21%. The interior basins with lower runoff coefficients are more vulnerable, with projected reductions of up to –68%. Water management strategies should therefore be spatially differentiated and targeted to the vulnerability of each sub-basin.
2. **The Drini Cascade as both a strategic asset and a hydromorphological pressure.** The Fierza–Koman–Vau i Dejës cascade is both the basin's most important water infrastructure asset and its most significant hydromorphological pressure. It provides approximately 90% of Albania's hydropower production, but it also strongly modifies the natural flow regime. The cascade changes the seasonal flow pattern, reduces or eliminates natural flood pulses, and can reduce downstream flows to zero on certain days. The analysis shows that the flow regime below Vau i Dejës is almost fully regulated, with natural lateral inflows contributing only 5–10% of total flow. Environmental flow requirements are therefore an important issue for the RBMP. The Q95 flow of 72 m³/s provides an initial reference point, while recorded 7-day minimum flows as low as 17.4 m³/s show that current operations can create periods of strong ecological stress downstream.
3. **Climate change will affect the water balance through both supply and demand.** The meteorological analysis shows that precipitation has remained approximately stable, with a change of +2%, while evapotranspiration has increased significantly by +5.5%. The water balance projections show that further warming will increasingly shift this balance. Under the moderate SSP2-4.5 mid-century scenario, mean runoff at the basin outlet declines by –18%. Under the high-emission SSP5-8.5 end-century scenario, the decline reaches –41%. In the worst-case scenario, the annual volume lost is estimated at 4,560 Mm³/year. This exceeds the combined active storage of the three cascade reservoirs, estimated at 2,751 Mm³. This means that storage infrastructure designed under wetter historical conditions may progressively lose part of its ability to buffer seasonal and inter-annual variability.
4. **From meteorology to management: an interconnected and transboundary vulnerability chain.** The analysis shows a clear chain of impacts. Rising temperatures increase evapotranspiration and reduce the rain-to-snow ratio. Reduced precipitation and increased evapotranspiration reduce mean runoff. Lower mean inflows reduce the generation capacity and operational flexibility of the Drini Cascade. Declining low flows increase ecological stress in individual water bodies, especially in water bodies that already have low dry-month flows. The transboundary character of the basin, including Lake Shkodra, the Buna River and upstream inflows from North Macedonia and Kosovo, can amplify these effects across national boundaries. This confirms the need for integrated, basin-wide water management, rather than separate sectoral or national responses.
5. **Priorities for the Programme of Measures.** Based on the analysis in this chapter, several priorities emerge for the RBMP Programme of Measures. First, minimum environmental flow releases should be established for each dam of the Drini Cascade, informed by the Q95 and seasonal flow duration curve data. Second, reservoir operating rules should be adapted to

account for projected inflow reductions under the climate scenarios. Third, monitoring and protection should be prioritised in the most vulnerable sub-basins, including the Drini i Bardhë and the interior reaches of the Drini i Zi, where runoff declines of 40–68% are projected. Fourth, transboundary coordination with Montenegro on Lake Shkodra and the Buna system, and with North Macedonia and Kosovo on upstream Drin inflows, should be strengthened to support coordinated management of declining water resources. Fifth, Albania should reduce its dependency on a hydropower system that is projected to lose 15–50% of its inflow within the current century by supporting a more diversified and climate-resilient energy mix.

CONCEPT

6 RIVER BASIN AIMS AND SIGNIFICANT WATER MANAGEMENT ISSUES

This chapter defines the overall management aims for the Drin-Buna Basin. It identifies the Significant Water Management Issues (SWMIs), such as hydro morphological alterations, nutrient pollution, water abstraction, and urban wastewater discharges. It provides the analytical foundation for later chapters on objectives, risk analysis, status assessment, and measures.

The detailed analysis on the River Basin aims, drivers and pressures and the Significant Water Management Issues, visions and management objectives can be found in Task Report 3. This Task Report was published for a 6-month public consultation period (May 2025 – October 2025), in compliance with the requirements of the Law on Public Consultation, Article 15 and Article 17 and the EU Directive 2000/60/EC (Article 14) Public Consultation on the development of River Basin Management Plans (see also Chapter 3).

6.1 Overall River Basin Aims and Significant Water Management Issues

6.1.1 Overall Drin-Buna River Basin aims

The SWMI analysis for the Drin-Buna River Basin was carried out in line with the requirements of the EU WFD and based on the DPSIR (Drivers–Pressures–State–Impact–Response) framework. The process combined analysis of available data, national and regional reports, and basin-specific monitoring results. All the identified issues were validated and further informed during a workshop and technical field visit to Drin-Buna RB - Shkodër, February 19 & 20, which brought together representatives from various stakeholders, including academia, universities, NGOs, regional and national agencies, and local government authorities.

The Overall River Basin Aims

To ensure sustainable water resources management in the Drin-Buna River Basin enabling the protection of the aquatic environment as well as a sustainable socio-economic development and water supply security. In detail, it is aimed for:

- to ensure good quality of surface waters and groundwaters by reducing relevant pressure;
- to ensure good/sufficient water quantity in surface waters and groundwaters through efficient water use.

The Overall River Basin Aims will be backed-up by more detailed *vision & objectives* to be achieved for each Significant Water Management Issue (SWMI):

1. *Climate Change and Impact on Water Resources*
2. *Hydro-meteorological Data & Monitoring*
3. *Protected Areas and Aquatic Ecosystems*
4. *Floods and Droughts*
5. *Pressures on the Hydro Morphology of Surface Waters (dams, hydropower, channel continuity, environmental flows and river morphology)*
6. *Pressures on Surface Water Quantity (water use, abstraction, and permitting)*
7. *Pollution from Urban Settlements and Industries (point sources pollution)*
8. *Pollution from Agriculture and other diffuse sources (diffuse sources pollution)*
9. *Pressures on Groundwater Quality & Quantity*
10. *Pressures on Coastal Waters (Quality, Bathing, Habitats and Erosion)*
11. *Transboundary WRM*

The SWMI visions reflect shared values regarding the jointly identified SWMI that are shared by the River Basin Committee and the involved stakeholders. The visions for the 11 SWMIs describe the principal objectives for the River Basin with a long-term perspective (20+ years).

6.1.2 Significant Water Management Issues, visions and management objectives

A total of 11 key SWMIs, have been analysed in the basin. These SWMIs represent the primary pressures and threats impacting the Drin-Buna River Basin and serve as a foundation for guiding water management planning in line with the EU WFD. As the Drin-Buna is a transboundary river basin, the overview also emphasizes the importance of regional cooperation with neighbouring countries Montenegro, Kosovo, North Macedonia, and Greece. This cooperation is particularly relevant in areas such as hydropower operation, pollution control, and sediment transport management.

SWMI 1 - Climate Change and impact on Water Resources

Climate change is expected to significantly affect water resources in the basin, with projected decreases in summer precipitation (–3 to –12%, depending on scenario) and increases in temperature (+1.2 - +3.0°C, depending on scenario) by 2060. This will intensify seasonal water scarcity, reduce groundwater recharge, and lower river runoff (-10 to – 42%, depending on scenario) by 2060, affecting drinking water supply, irrigation, hydropower, and ecological flows. Increased risks include droughts, wildfires, invasive species, and salinity intrusion due to sea level rise (up to 61 cm by 2100), alongside coastal erosion and wetland loss. More frequent extreme events will elevate flood risks in lowland areas (e.g. Nën-Shkodra, Lezhë) and trigger flash floods and landslides in mountainous regions. These pressures pose significant risks to achieving WFD objectives, including good status and no deterioration. To address this, Albania should integrate climate adaptation into RBMPs, strengthen inter-institutional coordination, and secure sustainable financing for resilience measures.

Vision: Addressing climate change in water management

Climate change scenarios for Southern Europe project declining precipitation and rising air temperatures, leading to reduced water availability across the country. To tackle this challenge, the RBM plan will integrate adaptation strategies aligned with key national policies, including:

- The Third National Communication on Climate Change
- The National Strategy for Integrated Water Resources Management
- The National Sectoral Program

By proactively incorporating these strategies, we can mitigate climate impacts and ensure sustainable water management for the future.

Management Objectives

- Integrate adaptation measures into the Program of Measures (PoM) within the RBM plan to enhance climate resilience.
- Assess and quantify the basin-specific impacts of climate change, focusing on precipitation, temperature, and variability, using the latest climate scenarios.
- Strengthen meteorological and hydrological monitoring at the basin level to develop accurate water balances for both surface and groundwater at the sub-basin level.
- Secure adequate funding and staffing to support improved monitoring efforts.
- Ensure real-time access and transparency in reservoir operations by sharing up-to-date data on water releases.

SWMI 2 - Hydro-meteorological Data & Monitoring

Effective water resources management requires reliable hydrological, meteorological, and water quality data; however, Albania faces significant gaps in monitoring infrastructure, funding, and institutional coordination.

Insufficient precipitation and flow monitoring limits flood forecasting capacity, particularly in high-risk areas such as Shkodër and Lezhë. Water quality monitoring remains inadequate for both chemical and ecological status, constraining compliance with WFD requirements. Groundwater monitoring is also limited, hindering the assessment of contamination risks in areas affected by legacy pressures (e.g. mining). These gaps affect the robustness of Article 5 risk assessments and status classification under Annex V. Strengthening monitoring networks, including real-time systems for hydrology and

reservoir operations, is essential to improve early warning and decision-making. Long-term investment and institutional coordination are required to ensure sustainable water management and full WFD compliance.

Vision: Strengthening water monitoring for effective water resources management

Reliable hydrological, meteorological, and water quality data for both groundwater and surface water are essential for sustainable water resources management. To address this, the RBM plan will emphasize the need for a robust monitoring network and program. A well-functioning monitoring system will:

- Assess climate change impacts on water resources.
- Support effective water allocation.
- Enhance flood forecasting capabilities.
- Strengthen drought management strategies.
- Improve water quality management and environmental flow regulation.
- Ensure compliance with the EU WFD.

By prioritizing data-driven decision-making, we can safeguard water resources and enhance resilience to climate change.

Management Objectives

- Establish a cooperation mechanism among relevant institutions for water resources data exchange, formalized through a Memorandum of Understanding (MoU).
- Develop a *national water resources database* consolidating all relevant water resources monitoring data, ensuring transparent and accessible information.
- Enhance meteorological and hydrological monitoring across the basin to generate reliable water balances at the sub-basin level for both surface and groundwater.
- Secure adequate funding and staffing to strengthen monitoring programs.
- Ensure real-time sharing of reservoir operation data, including water release volumes.
- Reinstate and operate critical flow measurement stations as a priority, under the responsibility of a competent State Agency.

SWMI 3 - Protected Areas and Aquatic Ecosystems

The degradation of protected areas and aquatic ecosystems remains a key concern, driven by institutional gaps, incomplete designation of protected zones, and insufficient mapping (Article 6, Annex IV WFD). Drinking water sources are inadequately protected, increasing risks to public health and chemical status. Hydromorphological pressures, including hydropower dams and gravel extraction, disrupt sediment transport and degrade habitats, contributing to coastal erosion. Additional pressures include overfishing, invasive species, pollution from diffuse and point sources, and impacts from urbanisation and tourism. These combined pressures threaten biodiversity, ecosystem services, and the achievement of WFD ecological and chemical objectives.

Vision: Integrating EU protected area objectives into the RBM Plan

The RBM plan aligns with EU legislation to safeguard Protected Areas and Aquatic Ecosystems, as outlined in the EU WFD (Annex IV). These Protected Areas include:

- Drinking water sources – areas designated for the abstraction of water for human consumption.
- Economically significant aquatic ecosystems – habitats supporting commercial fisheries and aquaculture.
- Recreational waters – including bathing waters and other designated leisure water bodies.
- Nutrient-sensitive zones – including vulnerable areas affected by nutrient pollution.
- Biodiversity protection zones – habitats and species conservation areas, including Natura 2000 sites.

The long-term protection of these critical areas will be ensured through the implementation of the Program of Measures (PoM) within the RBM plan, securing their ecological and economic value for future generations.

Management Objectives

- Map and officially designate Protected Areas for both surface water and groundwater.
- Define clear objectives and assess the status of Protected Areas in alignment with EU regulations.
- Secure sufficient funding and staffing to establish a dedicated monitoring program for Protected Areas.
- Enforce regulations and strengthen compliance to protect designated areas and meet conservation objectives.

SWMI 4 - Floods and Droughts

Flooding in the Drin-Buna Basin is addressed as a single, integrated risk, focusing on events causing significant damage. Increased flood frequency is driven by climate change, land use pressures, sedimentation, and reduced drainage and reservoir capacity. While regulatory frameworks, FRMPs, and early warning systems are in place, implementation remains constrained by funding and infrastructure gaps. Key priorities include strengthening flood protection infrastructure, improving drainage management, and enhancing municipal emergency response. Effective implementation is essential to reduce flood risks and support climate-resilient water management under the WFD and Floods Directive.

Vision: Stronger action to prepare for floods and droughts

We must take stronger action to prepare for floods and droughts. Climate change will intensify their impact:

- Flooding directly affects local communities by damaging homes and weakening the economic stability. It devastates agricultural land, disrupts drinking water supplies, and increases health risks. Critical infrastructure also suffers, leading to widespread consequences.
- Drought spells hit agricultural production the hardest. They also disrupt municipal water supplies. The growing imbalance between water demand and available resources is no longer an exception, it's becoming the norm.

A Flood Risk Management Plan is in place, fully aligned with the EU Floods Directive, along with the first phase of the Drin-Buna River Basin Management Plan. The key challenge now is securing funding for implementation and carrying out infrastructure measures for flood protection. The RBM plan will integrate targeted adaptation strategies and essential measures to tackle these challenges both now and in the future.

Management Objectives

- Integrate measures identified in the Flood Risk Management Plan into the Program of Measures (PoM) to ensure climate resilience.
- Quantify the basin-specific impacts of climate change, focusing on precipitation, temperature, and variability, using the latest climate scenarios.
- Ensure data-driven decision-making for water resource management through enhanced meteorological and hydrological monitoring.
- Continue with implementation of a Flood Early Warning System to provide timely alerts to populations at risk.
- Continue with implementation of dedicated spatial planning strategies tailored to flood-prone regions.
- Develop and implement an Action Plan for Drought Protection, recognizing that, although Albania is not highly exposed to drought impacts, proactive measures are essential for long-term resilience.

SWMI 5 - Pressures on the Hydro Morphology of Surface Waters (dams, hydropower, channel continuity, environmental flows and river morphology)

Hydromorphological alterations in rivers and floodplains are driven by flood protection works, urban development, unregulated construction, and aging infrastructure. Although requirements for fish passage and ecological continuity exist, enforcement and compliance remain insufficient. These pressures negatively affect ecological status and habitat connectivity under the WFD. Clear environmental objectives (Article 4) are essential to guide monitoring (Annex V), define user responsibilities, and ensure effective implementation and compliance.

Vision: Sustainable management of river systems

Rivers and their natural resources are managed sustainably, balancing economic development with ecosystem restoration, to support the development of self-sustaining ecosystems and maintain natural flow dynamics, while also addressing the impacts of climate variability.

Through sound water management and spatial development, river resources are safeguarded to ensure long-term economic and ecological balance and resilience.

Management Objectives

- Ensure the protection and sustainable management of river ecosystems through national policies and regulations.

- Maintain and restore natural flow dynamics to support biodiversity and ecosystem resilience.
- Establish flow regulations that balance ecosystem needs and water use, in order to minimize the negative impacts of hydro morphological alterations to ensure river continuity and habitat connectivity.
- Ensure sustainable management of river morphology and minimizing environmental impacts to protect aquatic ecosystems and water resources.
- Enforcement and compliance with the Law to construct fish passages along with new hydrotechnical infrastructure.
- Ensure effective monitoring of ecological flow by standardizing processes and enhancing staff capacity to improve data accuracy and compliance with environmental regulations.

SWMI 6 - Pressures on Surface Water Quantity (water use, abstraction, and permitting)

Water abstraction is dominated by agriculture, but weak user formalisation and limited inter-institutional coordination hinder effective governance. The absence of an updated water cadastre and harmonised datasets constrains accurate assessment of water use and availability. Insufficient permitting and control, particularly for hydropower and gravel extraction, impact surface water quantity and WFD objectives. These gaps limit compliance with Article 5 assessments and sustainable allocation under Article 4. Priority actions include formalising users, strengthening monitoring and data systems, and improving permitting and enforcement.

Vision: Ensure the sustainable use of surface waters

To ensure the sustainable use of surface waters, guaranteeing water security and availability while proactively addressing the impacts of climate variability. Responsible management and adaptive strategies to maintain balanced water distribution, support ecosystem resilience, and safeguard long-term water resources for all users.

Management Objectives

- Establishment of a cooperation mechanism among relevant institutions for water resources data exchange, formalized through a Memorandum of Understanding (MoU).
- Develop standardized technical procedures for establishing water balances at the sub-basin level to improve resource allocation and sustainability.
- Enhance meteorological and hydrological monitoring across the basin to ensure the accuracy and reliability of water balance assessments.
- Enable real-time sharing of reservoir operation data, including water release volumes, for greater transparency and planning.
- Implement a standardized quarterly reporting system for water abstractions, ensuring all data is stored in the *national water resources database*.
- Update, standardize, and enforce the Register of Abstractions, requiring all operators to register and report abstraction levels.
- Identify and document all illegal or non-permitted abstractions; strengthen licensing and enforcement – significant surface water abstraction without a proper permit is strictly prohibited.

SWMI 7 - Pollution from Urban Settlements and Industries (point sources pollution)

Urban and industrial wastewater discharges constitute a major pressure in the Drin-Buna Basin, with limited WWTP coverage and underperforming infrastructure. Industrial discharges are insufficiently monitored, with gaps in permitting and control, including aquaculture practices. Uncontrolled household and industrial wastewater leads to significant pollution and ecological degradation. These pressures pose risks to achieving good ecological and chemical status under the WFD and compliance with the UWWTD. Priority actions include long-term WWTP investment, infrastructure upgrades, improved permitting, and establishment of a national discharge register.

Vision: Minimizing untreated sewage discharge and reducing contamination risk

The goal is to achieve close-to-zero discharge of untreated sewage water from urban and industrial sources by implementing cost-effective technologies. Additionally, it is essential to minimize contamination from abandoned industrial sites, urban and industrial waste disposal sites, and mining sites.

Management Objectives

- Reduce untreated wastewater discharge from urban, industrial, and agricultural sources.

- Enhance wastewater treatment infrastructure through strategic investment and expansion of treatment capacity.
- Minimize pollution from contaminated sites, including industrial waste areas, mining zones, and landfills.
- Improve sewerage networks to prevent leaks, overflows, and groundwater contamination.
- Promote wastewater reuse in agriculture, industry, and urban applications.
- Strengthen regulatory frameworks for wastewater management, monitoring, and enforcement.
- Increase public awareness and engagement to prevent riverine pollution and promote sustainable water management.

SWMI 8 - Pollution from Agriculture and other Diffuse Sources (diffuse sources pollution)

Diffuse agricultural pollution (N, P, pesticides) is an increasing pressure on surface and groundwater, particularly in the western lowlands and Shkodra region. Insufficient buffer zones and limited monitoring contribute to eutrophication and local algae blooms. Intensive use of fertilisers and pesticides threatens drinking water quality, soils, and biodiversity. These pressures risk non-compliance with WFD objectives and require alignment with the Nitrates Directive. Key measures include nutrient management, enforcement of good agricultural practices, strengthened monitoring, and establishment of buffer zones.

Vision: Reducing diffuse agricultural pollution

Diffuse source pollution from agriculture, caused by nitrogen, phosphorus, and pesticides should be managed to prevent degradation of groundwater and surface water quality that could pose risks or threats to the aquatic ecosystems, the biodiversity and human health.

Management objectives

- Reach nitrogen and phosphorus (N and P) concentrations in all water bodies as defined in the Albanian standards.
- Promote sustainable agricultural practices to limit the discharge of nutrients and pesticides into surface and groundwater.
- Establish advice and training programs to farmers in proper storage, handling and disposal of pesticide substances.
- Implement safety measures to prevent and mitigate accidental pollution from agricultural activities.
- Strengthen regulatory frameworks for monitoring and enforcing agricultural pollution control measures.

SWMI 9 - Pressures on Groundwater Quality & Quantity

Groundwater is a critical resource in the Drin-Buna Basin, supplying ~90% of drinking water, but is increasingly under pressure from over-abstraction, pollution, and insufficient protection. Both porous and karst aquifers are vulnerable to contamination, particularly from agriculture and unregulated activities, as well as seawater intrusion in coastal zones. These pressures threaten groundwater quantitative and chemical status under the WFD. Groundwater also plays a key role in sustaining river flows and ecosystems, especially during low-flow periods. Monitoring remains limited, with few stations and low temporal resolution, constraining robust status assessment (Annex V). The hidden nature of groundwater increases uncertainty and risk of undetected deterioration. Improved classification of groundwater bodies, strengthened monitoring, and enhanced protection measures are essential. Ensuring compliance with WFD objectives requires sustainable abstraction, pollution control, and long-term resource management.

Groundwater quality

Vision: Ensuring and restoring groundwater quality for sustainable use and environmental protection

Maintain groundwater quality at levels suitable for all legitimate uses, ensuring it poses no risk to human health or ecosystems. Where groundwater has already been degraded due to human activities, the goal is to restore it to good quality, aligning with environmental standards. Groundwater should not only be viewed simply as a drinking water source but also as a vital component of ecosystems, requiring protection and sustainable management.

Management objectives – Groundwater quality

- Align with the objectives of SWMI 7 and 8 to enhance integrated water resource management.
- Establish groundwater protection zones for drinking water abstraction areas to ensure long-term water security.
- Strengthen groundwater quality monitoring system to accurately assess status and trends (see also SWMI 2).

- Strengthen governance, funding, and institutional capacity to ensure effective groundwater monitoring, enforcement, and management. Prevent contamination from key pollution sources, including agriculture, industry, and urban wastewater, by enforcing strict water quality regulations.

Groundwater quantity

Vision: Ensure long-term sustainable use of groundwater resources

Groundwater must be managed to ensure sustainable availability for all legitimate uses while maintaining resilience against climate change and human pressures. By implementing integrated groundwater management strategies, we will balance abstractions with natural replenishment, safeguarding groundwater as a critical resource for future generations.

Management objectives – Groundwater quantity

- Maintain groundwater availability at sustainable, ensuring no risk to human health or ecosystems.
- Balance abstractions with natural replenishment preventing over-extraction and long-term depletion.
- Strengthen groundwater quantity monitoring system to accurately assess status and trends (see also SWMI 2).
- Strengthen governance, funding, and institutional capacity to ensure effective groundwater monitoring, enforcement, and management.
- Regulate and monitor water abstractions by standardizing permitting processes and enforcing compliance.
- Develop a scientific understanding of groundwater systems, including transboundary aquifers, to enable coordinated management.
- Promote conjunctive use of groundwater and groundwater recharge.
- Reduce municipal water supply losses to a maximum of 10% through improved infrastructure and efficiency measures.

SWMI 10 - Pressures on Coastal Waters (Quality, Bathing, Habitats and Erosion)

Coastal waters in the Drin-Buna Basin are ecologically and economically significant but highly vulnerable to riverine pollution, urbanisation, and tourism pressures. They are subject to WFD objectives and linked to the Bathing Water Directive and Marine Strategy Framework Directive. Monitoring indicates declining bathing water quality, particularly in Shëngjin and Velipojë, due to wastewater and diffuse pollution. Coastal zones are also increasingly affected by erosion, sea level rise, flooding, and saltwater intrusion. Seasonal tourism intensifies local water demand and pollution risks during low-flow periods. These pressures threaten ecological status, public health, and economic activities. Integrated coastal management, improved monitoring, and strengthened wastewater control are essential to ensure WFD compliance and climate resilience.

Vision: Sustainable coastal management in Albania

We are committed to implementing the Cross-Sectoral Coastline Management Plan (2017-2030) to protect and sustain Albania's coastal regions. Our approach directly addresses major threats such as erosion, overfishing, pollution, and the potential impacts of climate change, including sea level rise.

Albania's pristine and undisturbed coastal areas are among its most valuable natural assets. These regions include scientifically and ecologically significant wetlands, while the country's beaches and resorts serve as key drivers of tourism revenue. We are dedicated to preserving these natural treasures by ensuring high-quality bathing water along the entire coastline, safeguarding both the environment and the economic potential of our coastal zones.

Management Objectives

- Review the existing Cross-Sectoral Coastline Management Plan and align its ambition and strategy with the vision and ambitions of the River Basin Management Plan.
- Protect and restore coastal ecosystems to combat erosion with nature-based solutions, establish and maintain protected coastal areas and preserve wetlands and biodiversity.
- Improve water quality and reduce pollution (see also SWMI 3, 7 and 8).
- Ensure sustainable fisheries and maritime management by implementing quotas and eco-friendly fishing practices and establish marine protected areas and restoration plans.
- Adapt to climate change and rising sea levels (see SWMI 1).
- Promote responsible and sustainable tourism, to encourage eco-tourism, regulate coastal development to prevent environmental damage and raise awareness among tourists and local communities.

- Strengthen governance and collaboration to enforce coastal management and environmental laws.
- Construction of coast-parallel dikes

SWMI 11 - Transboundary Water Resources Management

Transboundary water management in the Drin Basin is essential due to shared rivers, lakes, and aquifers, requiring coordinated action in line with WFD Articles 3 and 13. The basin supports over 1.6 million people and is of high ecological and economic importance, notably for hydropower and biodiversity. Historically fragmented management has led to pressures such as pollution, flooding, and inefficient resource use. Since the 2011 Drin MoU, regional cooperation has improved through joint governance structures, data sharing, and coordinated planning. Albania's legal framework (Law No. 29/2024) strengthens transboundary cooperation, including joint planning, monitoring, and impact assessment. Institutional mechanisms, including the Transboundary Water Commission and AWRM, support implementation. Despite progress, challenges remain in harmonisation, capacity, and effective coordination. Strengthening cross-border cooperation is essential to achieve WFD objectives and sustainable basin-wide management.

Vision: joint action for the coordinated integrated management of the shared water resources

To 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

Management Objectives

- **Strengthen transboundary coordination for RBMP implementation.** Ensure that Albania actively cooperates with Montenegro, North Macedonia and Kosovo in the implementation of WFD Articles 3 and 13, including coordination of river basin planning, monitoring, status assessment, environmental objectives and Programmes of Measures for shared rivers, lakes, groundwater bodies and protected areas.
- **Improve joint monitoring, data exchange and assessment.** Develop regular and structured exchange of hydrological, chemical, ecological, groundwater, flood and drought data through the existing Drin cooperation mechanisms. This should support comparable assessment methods, shared understanding of pressures and risks, and better evidence for management decisions across the basin.
- **Coordinate the management of key transboundary pressures.** Address pressures that cannot be managed effectively by one country alone, including pollution loads, hydropower regulation, sediment transport, flood risk, drought impacts, groundwater abstraction and pressures on Lake Shkodra, Lake Ohrid, the Buna River and shared aquifers.
- **Protect and restore transboundary ecosystems and ecosystem services.** Safeguard the ecological functioning of shared rivers, lakes, wetlands, floodplains, groundwater-dependent ecosystems and coastal waters.
- **Strengthen institutional capacity and legal implementation.** Use Albania's Law No. 29/2024, the Drin Memorandum of Understanding and the work of the Drin Core Group, the Transboundary Water Commission and AWRM to improve joint planning, consultation, monitoring, impact assessment and implementation. Capacity building should focus on harmonised WFD methods, practical cooperation between authorities and effective follow-up of agreed measures.

6.2 Main findings and priority actions

The SWMI analysis confirms that the Drin-Buna basin is under combined pressure from natural dynamics, human activities, and governance gaps. Key findings include:

- **Monitoring and knowledge gaps:** Current monitoring does not capture the full state of water bodies. Data on quantity, quality, and ecosystems remain fragmented, making it difficult to track long-term changes or design targeted measures.
- **Hydro-morphological pressures:** The Buna, Drin, and their tributaries are heavily modified by regulation works, flood protection structures, and water abstraction. Hydropower plants in upstream stretches alter flow regimes and reduce continuity, impacting downstream habitats and sediment transport.
- **Urban and industrial pollution:** Wastewater treatment infrastructure is largely insufficient. Urban discharges from Shkodra, Lezha, and other settlements, combined with industrial effluents, contribute nutrients and bacteriological loads to rivers and lagoons.

- **Diffuse agricultural pollution:** Farming in lowland areas contributes nitrogen, phosphorus, and pesticides to surface waters. Absence of protective buffer zones along rivers and drains increases runoff and nutrient loads.
- **Groundwater vulnerability:** Shallow aquifers in lowland areas are used for irrigation and drinking water supply but face risks from over-abstraction and pollution linked to settlements and agriculture.
- **Bathing and coastal waters:** According to the State of the Environment Report (NEA, 2023), Velipojë and Shëngjin show a marked decline. In Velipojë, only one station was excellent, while others were good or sufficient. In Shëngjin, quality deteriorated sharply from excellent in 2022 to predominantly poor or sufficient in 2023. These trends indicate increasing microbiological risks for recreation and tourism.
- **Climate risks:** Seasonal floods and droughts affect both upstream hydropower regulation and downstream floodplains, stressing water allocation, habitats, and infrastructure.
- **Transboundary dimension:** The Drin-Buna basin is shared with Montenegro, Kosovo, and North Macedonia. Lack of harmonized monitoring and limited data exchange constrain effective cooperation and management of shared waters.

7 CHARACTERISATION AND DELINEATION OF WATER BODIES

In line with Article 5 and Annex II of the WFD, this chapter describes the typology, delineation, and characterisation of surface and groundwater bodies in the Drin-Buna River Basin. It explains the criteria and datasets used to define homogeneous units for assessment and management. The section also includes an overview of the delineated Protected Areas, such as drinking water zones, Natura 2000 equivalent sites, and bathing waters. This characterisation provides the spatial and ecological framework for risk and status evaluation, monitoring, and the development of the Programme of Measures.

Detailed analyses of the delineation, and characterisation of surface and groundwater bodies in the Drin-Buna River Basin has been prepared and reported in Task Report 1.

7.1 Introduction

The delineation of surface water bodies, groundwater bodies and protected areas forms a fundamental step in the implementation of the WFD⁷⁴ and in the preparation of the Drin-Buna River Basin Management Plan. By defining these management units, the competent authorities establish the spatial basis for monitoring, risk assessment, status classification, and the development of targeted programmes of measures.

Surface water bodies include rivers, lakes, transitional waters, and coastal waters. They are identified and delineated according to their natural characteristics, typology, hydrological continuity, hydro morphological conditions, and significant pressures. This enables the application of type-specific reference conditions and ecological quality ratios, as required under WFD Annexes II and V.

Groundwater bodies are delineated on the basis of hydrogeological boundaries, aquifer characteristics, groundwater flow systems and their interaction with surface waters and groundwater-dependent terrestrial ecosystems. Their delineation supports the assessment of both quantitative and chemical status and allows pressures such as over-abstraction, pollution, and saline intrusion to be addressed at the appropriate management scale⁷⁵.

Protected areas, including drinking water protection zones, bathing waters, nitrate vulnerable zones, areas important for habitats and species, and areas supporting economically significant aquatic species, are integrated into the WFD framework through Article 6 and Annex IV. Their identification ensures that objectives beyond general good status are also addressed where relevant.

Together, the delineation of water bodies and protected areas provides the operational structure for river basin management. It clarifies where status must be assessed, where objectives apply, where pressures need to be managed, and where measures must be implemented. Without this spatial framework, monitoring, assessment, and programme of measures would lack coherence, traceability, and accountability.

⁷⁴ European Commission (2003). Common Implementation Strategy for the WFD: Guidance Document No. 2 – Identification of Water Bodies. Luxembourg: Office for Official Publications of the European Communities.

⁷⁵ European Commission (2007). CIS Guidance Document No. 15 – Guidance on groundwater monitoring. Luxembourg: Office for Official Publications of the European Communities.

7.2 Characterisation of Surface Water Bodies

7.2.1 Methodological basis

The WFD defines a surface water body as a distinct and significant element of surface water, such as a river, stream, lake, reservoir, canal, transitional water, or coastal water. Within the Drin-Buna River Basin, surface water bodies are used as the primary management units for assessing ecological and chemical status and for setting environmental objectives.

Each surface water body must be clearly delineated by its geographical location and boundaries. The delineation must be detailed enough to allow a reliable comparison between observed conditions and the environmental objectives of the WFD. At the same time, unnecessary fragmentation must be avoided. The delineation should therefore strike a balance between technical accuracy and practical manageability: water bodies should be sufficiently homogeneous for assessment and management but not divided into units that add no value for implementing the RBMP.

The delineation process considers three main factors:

1. **Surface water category and typology**
Water bodies are first assigned to the relevant WFD category: rivers, lakes, transitional waters, coastal waters, artificial water bodies, or heavily modified water bodies. They are then differentiated into types using descriptors such as altitude, catchment size, and geology.
2. **Natural boundaries and hydro morphological characteristics**
Changes in river size, altitude class, geology, hydrological regime, lake or reservoir character, and river continuity may require delineation into separate water bodies.
3. **Significant pressures and expected status changes**
Major pressures, such as wastewater discharges, mining impacts, hydropower installations, abstractions, flood protection works or urban areas, may require upstream and downstream sections to be delineated separately where different status conditions are expected.

This approach ensures that each delineated water body represents a meaningful and coherent management unit for monitoring, classification, and the programme of measures.

7.2.2 Surface water categories and typology

Under the WFD, all surface waters must be assigned to one of the following categories: rivers, lakes, transitional waters, or coastal waters. Water bodies may also be designated as artificial water bodies (AWB) or heavily modified water bodies (HMWB)⁷⁶, where the conditions set out in WFD Article 4(3) are met.

Transitional waters are located near river mouths and are partly saline because of their proximity to coastal waters, while still being substantially influenced by freshwater flows. Coastal waters extend one nautical mile from the landward baseline. In Albania, transitional and coastal waters fall within *Ecoregion 6: Hellenic Western Balkan*.

Artificial water bodies are surface waters created by human activity. Heavily modified water bodies are natural water bodies that have been substantially changed in character as a result of physical alterations caused by human use. These designations are relevant for the environmental objectives of the RBMP. Natural water bodies aim to achieve Good Ecological Status and good chemical status, whereas AWBs and HMWBs aim to achieve Good Ecological Potential and good chemical status. Such designations must be justified transparently in the RBMP and cannot be used simply to legitimise existing pressures.

For typology, the WFD allows the use of System A or System B. System A applies a fixed set of descriptors, including ecoregion, altitude, size, and geology. System B allows additional or alternative descriptors where sufficient data are available. In Albania, and therefore also for the Drin-Buna River Basin, System A provides the most appropriate basis at this stage, because biological, hydrological, and ecological datasets remain incomplete.

⁷⁶ Annex II, CIS Guidance No. 4 on HMWB/AWB

Typology is essential because ecological status is assessed by comparing observed conditions with type-specific reference conditions. Different river or lake types have different natural characteristics and therefore different reference conditions. A high-altitude mountain stream, for example, cannot be assessed against the same ecological expectations as a lowland river. The main descriptors used for typology are:

- **Altitude**, which influences temperature regimes and biological communities.
- **Size**, which affects flow magnitude, habitat extent, river continuity, and ecological functioning.
- **Geology**, which determines natural water chemistry and supports different aquatic communities.

Typology therefore forms the conceptual link between natural conditions, monitoring, status assessment, and environmental objectives.

7.2.3 Delineation principles for the Drin-Buna River Basin

In the Drin-Buna River Basin, delineation follows the WFD principle that one water body should not cross a major typological boundary. Where a river changes from one altitude class to another, where catchment size changes significantly, or where geological conditions differ, a separate water body may need to be defined. This ensures that reference conditions and status assessment remain internally consistent.

Delineation must also reflect significant pressures and impacts. A river reach upstream of a major discharge, abstraction, hydropower installation, or mining-affected tributary may have different ecological or chemical status from the reach downstream. In such cases, separate water bodies should be delineated to ensure that monitoring results, risk assessment and measures are correctly linked to the affected section.

The same principle applies to hydro morphological pressures. Dams, reservoirs, flow diversions, flood protection structures, and channel modifications can alter river continuity, flow regime, sediment transport, and habitat conditions. Where such pressures substantially change the character or functioning of a river reach, the delineation should capture these changes. Where relevant, the water body may be assessed for possible HMWB designation, subject to the full WFD Article 4(3) test.

The delineation must also be forward-looking. Future developments, such as urban expansion, new wastewater treatment infrastructure, water supply abstractions, hydropower development, irrigation schemes or flood protection measures, may change pressures and status. For this reason, long river sections should not be over-aggregated where future status differences are likely. A stable delineation framework reduces the need for repeated changes to water body identifiers and improves continuity between RBMP cycles.

At the same time, the current monitoring network in Albania does not yet provide status information for all delineated water bodies. The delineation for the Drin-Buna RBMP therefore combines available data with expert judgement. This is a pragmatic and WFD-consistent approach for this planning cycle, provided that uncertainties are clearly documented and progressively reduced through improved monitoring.

7.3 Surface Water Bodies in the Drin-Buna River Basin

Surface water bodies are defined as distinct and significant units of surface water, including rivers, lakes, transitional waters, and coastal waters. Artificial Water Bodies (AWBs) and Heavily Modified Water Bodies (HMWBs) are identified separately where physical alterations or artificial origin require a different ecological objective.

7.3.1 River water bodies

For rivers, the WFD-based delineation applies both catchment size and length criteria. As a general rule, rivers with a contributing catchment larger than 10 km² or a river length exceeding 10 km are delineated as separate water bodies. Smaller watercourses are normally not delineated unless they have specific

ecological, management or policy relevance, for example where they affect protected areas, drinking water abstractions, bathing waters, Natura 2000-related values, or are subject to significant pressures. All river and lake water bodies in Albania, including those in the Drin-Buna River Basin, fall within *Ecoregion 6: Hellenic Western Balkan*.

The Drin-Buna River Basin includes **49 river water bodies**. Their characterisation follows System A of WFD Annex II, using altitude, catchment size, and geology as key typology descriptors. The delineation also considers hydrological regime, hydro morphological pressures, ecological relevance, and likely differences in status. The river water body codes follow the Pfafstetter system⁷⁷.

River flow regime is a key element for understanding reference conditions and ecological functioning. Where data are available, the flow regime is described using Q10, Q50 and Q90 values, representing high, median, and low-flow conditions. Q50 provides a representative measure of average flow, while Q90 is particularly relevant for low-flow and environmental-flow assessment. The ratio Q90/Q50 is used as an indicator of groundwater contribution to river discharge, known as the Base Flow Index (BFI). In Albanian river basins, groundwater commonly contributes at least 30% of annual river flow⁷⁸ and may dominate discharge during summer low-flow periods. Protecting this groundwater-supported baseflow is therefore essential for maintaining environmental flows and aquatic ecosystem functioning.

7.3.2 Lake water bodies

The Drin-Buna River Basin also includes **9 lake water bodies**, characterised under System A of WFD Annex II. Lake typology uses altitude, geology, size, and depth. Because many Albanian lakes function as reservoirs, the typology also includes the typical annual water-level fluctuation, which directly affects shoreline habitats, littoral zones, and ecological status. Most lake water bodies in the basin are artificial or strongly regulated reservoirs created for irrigation and/or hydropower.

The lakes and reservoirs of the Drin-Buna River Basin form a diverse system of natural tectonic lakes, lowland floodplain lakes and large artificial reservoirs. Together, they play a central role in the basin's hydrology, ecology, water management and hydropower production. The system includes internationally important transboundary lakes, major hydropower reservoirs in the Drin Cascade, and smaller local lakes and reservoirs that support irrigation, agriculture and floodplain functioning.

Overall, the lakes and reservoirs define the hydrological identity of the Drin-Buna River Basin. The Prespa–Ohrid lake system controls important upstream and groundwater interactions; Lake Shkodra regulates the lower basin and supports floodplain and wetland functioning; and the Drin Cascade provides major engineered control over flows for hydropower and flood management. Smaller lakes and reservoirs provide additional local functions for irrigation, agriculture and floodplain hydrology. Most natural lake water bodies in the basin remain ungauged and unmonitored, meaning that their inflow regimes are not yet well quantified. The main exceptions are Lake Ohrid and Lake Shkodra.

7.3.3 Transitional water bodies

The Drin-Buna River Basin also includes **4 transitional water bodies**. Transitional waters are located near river mouths, are partly saline due to their proximity to coastal waters, and remain substantially influenced by freshwater flows. In Albania, transitional waters have not previously been systematically delineated in RBMPs, and no specific national reference conditions have yet been established. For the Drin-Buna River Basin, the downstream transition from river water to transitional water was approximated using a mean tidal range of ± 30 cm. This approach defines two transitional river water bodies: the lower Buna River, extending approximately 3.2 km upstream from its mouth, and the Drini i Lezhës, with a transitional reach of about 4.3 km. The transitional water bodies are characterised using System A of WFD Annex II and are shown in the relevant RBMP maps.

⁷⁷ The RBMP has defaulted to the European-wide river basin numbering system derived from the EC JRC "Catchment Characterisation and Modelling (CCM) coding system. For river waterbodies, the Pfafstetter coding system has been applied.

⁷⁸ Science Academy of Albania, Institute of Hydro-meteorology – "The Hydrology of Albania", Tirana, 1984

7.3.4 Coastal water bodies

For coastal waters, the main objective is to assign coastal stretches to the most appropriate river basin management unit while avoiding unnecessary subdivision. Coastal lagoons may be classified either as coastal or transitional waters, depending on their salinity regime and freshwater influence. In the Drin-Buna River Basin, **4 coastal water bodies** have been delineated and characterised using System A of WFD Annex II.

7.3.5 Artificial- and heavily modified water bodies

Finally, **17 water bodies** in the Drin-Buna River Basin have been designated as Artificial Water Bodies or Heavily Modified Water Bodies. AWBs are man-made water bodies, such as canals or artificial reservoirs created where no natural water body previously existed. HMWBs are originally natural water bodies that have been substantially changed in character by physical modifications such as dams, reservoirs, flow regulation, flood protection works, canalisation or water diversions. For both AWBs and HMWBs, the environmental objective is Good Ecological Potential (GEP) and good chemical status, rather than Good Ecological Status.

The designation of HMWBs must be justified under WFD Article 4(3). This means that the physical modifications must be necessary for important uses, such as hydropower, irrigation, flood protection, or water supply, and that the benefits of these uses cannot reasonably be achieved by technically feasible and significantly better environmental alternatives without disproportionate cost. HMWB and AWB designation must therefore remain evidence-based and transparent. For consistency, AWBs and HMWBs are assessed using the typology, quality elements, and assessment tools of the natural water category they most closely resemble.

Table 14 - Drin-Buna River Basin - Waterbody Characterisation – Category RIVERS⁷⁹.

River name	Subbasin	EU Code	Altitude (abs)	Area (km ²)	Geology	Typology	River Form	Length (km)	Width (m)	Ecoregion	Q10	Q50	Q90	BFI
Runica	Danub	3592	1520	26.57	Calcareous/mixed	R-11b	NWB	0.76	760	Pontic Province	2.28	1.59	1.07	0.67
Vermoshi	Danub	3591	1045.3	114.9	Calcareous/mixed	R-10b	NWB	10.3	271	Pontic Province	9.87	6.88	4.61	0.67
Buna	Drin - Bunë	35101	4.57	68.92	Calcareous/mixed	R-05	HMWB	36.9	621	Hellenic western Balkan	866.03	643.17	465.27	0.72
Buna	Drin - Bunë	351021	5.87	811.05	Calcareous/mixed	R-04	NWB	3.6	275	Hellenic western Balkan	456.26	317.84	213.26	0.67
Cemi downstream	Drin - Bunë	351026	239.27	41.74	Calcareous/mixed	R-11	NWB	7.9	60	Hellenic western Balkan	21.33	14.86	9.97	0.67
Cemi i Selcës	Drin - Bunë	3510264	935	78	Calcareous/mixed	R-11b	NWB	19.1	234	Hellenic western Balkan	6.7	4.67	3.13	0.67
Cemi upstream	Drin - Bunë	3510262	536	128.45	Calcareous/mixed	R-10	NWB	10.7	101	Hellenic western Balkan	11.04	7.69	5.16	0.67
Drini i Lezhës	Drin - Bunë	35111	5.09	286	Calcareous/mixed	R-04	HMWB	22.1	55	Hellenic western Balkan	12.56	8.99	6.05	0.67
Drini i Lezhës	Drin - Bunë	35112	33.52	58	Calcareous/mixed	R-05	HMWB	21.8	57	Hellenic western Balkan	1.89	1.35	0.91	0.67
Dry stream (prr. Thatë)	Drin - Bunë	351024	50.88	206.77	Calcareous/mixed	R-04	NWB	8.5	205	Hellenic western Balkan	17.77	12.38	8.3	0.67
Gjadëri (Lezhë)	Drin - Bunë	35114	12.87	42	Calcareous/mixed	R-03	NWB	15.9	53	Hellenic western Balkan	1.37	0.98	0.66	0.67
Kiri	Drin - Bunë	351034-1	458.7	233.95	Calcareous/mixed	R-10	NWB	43.6	187	Hellenic western Balkan	22.18	14.48	10.43	0.72
Kiri	Drin - Bunë	351034-2	25.5	65.41	Calcareous/mixed	R-05	NWB	11.5	481	Hellenic western Balkan	28.38	18.53	13.35	0.72
Varka	Drin - Bunë	351022	17.8	51.63	Calcareous/mixed	R-05	NWB	5.7	138	Hellenic western Balkan	4.44	3.09	2.07	0.67
Bushtrica (Drini Zi)	Drini i Zi	351092	440	148	Calcareous/mixed	R-10	NWB	9.9	126	Hellenic western Balkan	8.03	4.64	2.63	0.57

⁷⁹ In compliance with WFD Annex II, 1.2 System A – includes AWBs and HMWBs appropriate to the classification. For clarity, AWBs and HMWBs are also summarised under Table 2.9.

River name	Subbasin	EU Code	Altitude (abs)	Area (km ²)	Geology	Typology	River Form	Length (km)	Width (m)	Ecoregion	Q10	Q50	Q90	BFI
Drini i Zi	Drini i Zi	351091	302	43	Calcareous/mixed	R-11	HMWB	7.5	144	Hellenic western Balkan	130.67	91.39	62.45	0.68
Drini i Zi	Drini i Zi	351095	357	133	Calcareous/mixed	R-10	HMWB	10.6	384	Hellenic western Balkan	97.21	68.14	47.06	0.69
Drini i Zi	Drini i Zi	351099	456.1	117	Calcareous/mixed	R-10	HMWB	7.5	230	Hellenic western Balkan	70.18	49.19	33.97	0.69
Drini i Zi	Drini i Zi	3510931	304	49	Calcareous/mixed	R-11	HMWB	7.5	181	Hellenic western Balkan	122.51	83.15	55.3	0.66
Drini i Zi	Drini i Zi	3510933	317	63	Calcareous/mixed	R-11	HMWB	11.1	220	Hellenic western Balkan	117.12	79.5	52.86	0.66
Drini i Zi	Drini i Zi	3510971	374	103	Calcareous/mixed	R-10	HMWB	10.1	438	Hellenic western Balkan	92.02	64.5	44.55	0.69
Drini i Zi	Drini i Zi	3510973	440	267	Calcareous/mixed	R-10	HMWB	22	665	Hellenic western Balkan	86.69	60.77	41.97	0.69
Molla e Lurës	Drini i Zi	3510922	373.7	150	Siliceous	R-14b	NWB	6.3	31	Hellenic western Balkan	4.06	2.76	1.83	0.66
Murra	Drini i Zi	3510972	393.94	150	Siliceous	R-14b	NWB	5.1	54	Hellenic western Balkan	6.68	4.27	2.49	0.58
Sela	Drini i Zi	351096	506.3	89	Calcareous/mixed	R-11	NWB	8.1	210	Hellenic western Balkan	2.41	1.63	1.09	0.66
Veleshica	Drini i Zi	351094	834	104	Calcareous/mixed	R-10b	NWB	13	279	Hellenic western Balkan	2.9	1.97	1.31	0.66
Zalli i Bulqizës	Drini i Zi	351098	673.4	440	Calcareous/mixed	R-10	HMWB	58.9	276	Hellenic western Balkan	19.45	12.36	7.1	0.57
Bushtrica	Kaskada Drinit	351062	857	207.71	Calcareous/mixed	R-10b	NWB	42.3	196	Hellenic western Balkan	4.23	2.72	1.64	0.6
Curraj	Kaskada Drinit	35105	544	152.79	Calcareous/mixed	R-10	NWB	21.8	173	Hellenic western Balkan	14.68	10.02	6.57	0.66
Dardhë	Kaskada Drinit	3510714	390	18.95	Siliceous	R-09	NWB	2.7	30	Hellenic western Balkan	0.18	0.11	0.07	0.6
Drin	Kaskada Drinit	351031	5.7	0.66	Calcareous/mixed	R-05	HMWB	1.8	619	Hellenic western Balkan	434.51	319.14	228.89	0.72
Drin	Kaskada Drinit	3510321	5.7	28.84	Calcareous/mixed	R-05	HMWB	18.5	1500	Hellenic western Balkan	419.18	300.22	202.04	0.67
Drini i Bardhë	Kaskada Drinit	351082	307.7	62.82	Calcareous/mixed	R-11	HMWB	6.7	806	Hellenic western Balkan	88.93	57.23	34.6	0.6
Gashi	Kaskada Drinit	3510644	1042	110.49	Calcareous/mixed	R-10b	NWB	21	100	Hellenic western Balkan	7.9	6.03	4.5	0.75
Gjadër	Kaskada Drinit	3510322	377	199.2	Siliceous	R-14b	NWB	42.4	460	Hellenic western Balkan	11.91	8.15	5.83	0.71

River name	Subbasin	EU Code	Altitude (abs)	Area (km ²)	Geology	Typology	River Form	Length (km)	Width (m)	Ecoregion	Q10	Q50	Q90	BFI
Gomsiqe	Kaskada Drinit	3510324	357	142.25	Siliceous	R-14b	NWB	25.8	161	Hellenic western Balkan	9.27	6.21	3.84	0.62
Kalimashi	Kaskada Drinit	351078	488	35.95	Siliceous	R-14	NWB	17.6	37	Hellenic western Balkan	0.33	0.22	0.13	0.6
Kruma	Kaskada Drinit	351076	400	48.14	Siliceous	R-09	NWB	7.4	14	Hellenic western Balkan	0.98	0.63	0.38	0.6
Luma	Kaskada Drinit	351084	830	181.7	Siliceous	R-14b	NWB	19.6	54	Hellenic western Balkan	16.63	10.92	6.53	0.6
Mashi	Kaskada Drinit	3510712	325.3	28.06	Siliceous	R-09	NWB	1.8	13	Hellenic western Balkan	0.57	0.37	0.22	0.6
Sapaçi	Kaskada Drinit	3510326	378.6	49.72	Calcareous/mixed	R-11	NWB	7.6	108	Hellenic western Balkan	1.29	0.89	0.61	0.68
Serriqe	Kaskada Drinit	351074	431.7	100.7	Siliceous	R-14b	NWB	34.9	33	Hellenic western Balkan	0.94	0.6	0.36	0.6
Shala	Kaskada Drinit	35104-2	438	135.1	Calcareous/mixed	R-10	NWB	19.8	85	Hellenic western Balkan	25.81	16.98	10.6	0.62
Skatina	Kaskada Drinit	351072	574.3	77.41	Siliceous	R-14	HMWB	30.4	53	Hellenic western Balkan	1.57	1.01	0.61	0.6
Thethi	Kaskada Drinit	35104-1	866	64.64	Calcareous/mixed	R-11b	NWB	10.1	230	Hellenic western Balkan	8.35	5.49	3.43	0.62
Valbona	Kaskada Drinit	351061	241.7	83.16	Siliceous	R-14	NWB	10.6	312	Hellenic western Balkan	43.83	32.74	24.08	0.74
Valbona	Kaskada Drinit	3510641	254.2	40.2	Calcareous/mixed	R-11	NWB	7.5	111	Hellenic western Balkan	24.42	18.24	13.42	0.74
Valbona	Kaskada Drinit	3510642	950	215.32	Calcareous/mixed	R-10b	NWB	33.8	340	Hellenic western Balkan	15.4	11.74	8.76	0.75

More detailed calculations on the environmental flows, including exceedance probabilities of 50%, 75%, 80%, 85%, 90%, 95%, 97%, and 99% are analysed and presented in Task Report 1. Recommended values to be used for environmental flow are between 90% and 99%.

River Name	Subbasin	Brief description of the river
Runica	Danub	The Runica stream is a small, high-altitude watercourse (avg. elevation 1,520 m) located to the east of the Vermoshi valley, within the Danube River Basin. Covering a catchment area of just 26.6 km ² , it flows toward the Lim River. Despite its modest size and length (0.76 km in the characterised section), it contributes to the Black Sea drainage network and lies within the Pontic Province ecoregion.
Vermoshi	Danub	The Vermoshi sub-basin is a small, mountainous catchment located in the far north of Albania, within the Albanian Alps. Covering an area of approximately 115 km ² , it is characterised by steep terrain, high elevations (average altitude over 1,000 m), and significant winter snowfall. Unlike other sub-basins in the Drin-Buna system, the Vermoshi is hydrologically part of the Danube River Basin, with its waters flowing northeast into Montenegro and continuing via the Lim–Drina–Danube system toward the Black Sea. Although it does not drain into the Adriatic, the Vermoshi catchment is included in the administrative delineation of the Drin-Buna basin, for purposes of water resource monitoring, regional planning, and environmental management.
Buna	Drin - Bunë	Buna sub-basin forms the final lowland outlet of the wider Drin–Shkodra system to the Adriatic. The Buna River rises from Lake Shkodra at its southern end (in the city of Shkodra) and, within about 1.5 km downstream, it is hydraulically connected to the Drin: during high-flow periods the Drin can enter/occupy the Buna channel, while at other times flow conditions can reverse locally because of the very low gradient. The Buna is a short, distinctly lowland river (about 41 km long) with a gentle slope of roughly 1.2 m/km, flowing through young alluvial deposits and a broad floodplain environment. Hydrologically, Buna is strongly regulated by Lake Shkodra, which stores wet-season inflows and sustains discharge through the dry season; this natural buffering is consistent with a relatively stable baseflow component (high BFI values in your table). After the confluence influence with the Drin, Buna becomes a major conveyer of Drin waters to the sea: long-term mean discharge of the Buna is around 320 m³/s, representing a large share of the Drin system's outflow, and its mouth zone is characterised by active sediment transport and deposition, with continuous growth of the Buna delta and formation of islands/bars—features that also underpin flood risk and channel-morphology change in the lower reaches.
Cemi upstream	Drin - Bunë	The Cemi River is a small but hydrologically important transboundary tributary of the Drin–Buna system, originating in northern Albania and flowing northward into Montenegro, where it ultimately contributes to the Morača–Skadar drainage. In the Albanian classification it is divided into three natural water bodies: Cemi upstream (3510262), draining high mountain terrain around 536 m a.s.l. with a catchment of about 128 km ² ; Cemi i Selcës (3510264), a steeper alpine tributary (avg. altitude 935 m, area 78 km ²); and Cemi downstream (351026), the lower reach before the border (avg. altitude 239 m, area 42 km ²). All three are classified as natural water bodies (NWB), with moderate and stable flows (Q50 roughly 4–15 m ³ /s), and they form part of the Hellenic western Balkan ecoregion, characterised by steep valleys, coarse sediments, and high ecological value.
Drini i Lezhës	Drin - Bunë	Drini i Lezhës is a lowland water body located in the Lezhë floodplain, historically part of the Drin River's course. However, due to major river engineering works in the mid-20th century, the main Drin flow was diverted directly into the Buna River, and the original Drini i Lezhës channel was left hydrologically disconnected from the main Drin. Despite this, it retains the name and continues to function as a heavily modified water body (HMWB), receiving water from local drainage, wetlands, and smaller tributaries. With an altitude below 35 m and a total contributing area of around 340 km ² , Drini i Lezhës flows through flat alluvial plains, and its morphology is shaped by sedimentation, low gradients, and human interventions such as levees and flood protection works.
Dry stream (pr. Thatë)	Drin - Bunë	The Dry River is a medium-sized mountain tributary draining a 206.8 km ² catchment and flowing westward into Lake Shkodra. It is classified as a natural water body (NWB) and lies under the influence of the northern lowland Mediterranean climate, with moderately stable seasonal flows.
Gjadëri (Lezhë)	Drin - Bunë	The Gjadëri River is a small tributary in the Lezhë area, draining a 42 km ² catchment before flowing into the Drini i Lezhës. It is classified as a natural water body (NWB) with modest flows.
Kiri	Drin - Bunë	The Kiri River is a tributary of the Drin–Buna system, with a total upstream catchment of nearly 460 km ² . It originates in the mountainous areas east of Shkodra, at mean elevations exceeding 450 m, and descends through steep valleys before entering the lowland plains. The river is divided into two surface water bodies in the classification: an upper reach (351034-1) with rugged terrain and natural morphology, and a lower reach (351034-2) that crosses agricultural lands near the city of Shkodra. Despite the urban proximity, both reaches maintain relatively natural flow regimes, with stable baseflow conditions and moderate specific discharges. The Kiri is hydrologically and ecologically significant for the Shkodra region.

River Name	Subbasin	Brief description of the river
Varka	Drin - Bunë	The Varka River is a small tributary of the Drin-Buna system, draining a 51.6 km ² catchment in the Shkodra region. It is classified as a natural water body (NWB) with modest, stable flows and lies under the influence of the northern lowland Mediterranean climate.
Bushtrica (Drini Zi)	Drini i Zi	The Bushtrica River is a small tributary draining a 148 km ² catchment into the Drini i Zi, and is influenced by the northern Mediterranean climate.
Drini i Zi	Drini i Zi	The Drini i Zi (Black Drin) is the most significant tributary of the Drin-Buna river system, originating from Lake Ohrid at Struga in North Macedonia and flowing northward into eastern Albania. Its basin covers over 5,885 km ² and drains high-altitude regions influenced by both rainfall and snowmelt. In North Macedonia, its flow is regulated by two major dams: the Globocica and Spilje hydropower plants, which provide energy production and flow control before the river enters Albania. Once in Albania, the Drini i Zi continues toward Kukës, where it is impounded again by the Fierza reservoir, the largest in the country, forming a cascade system together with downstream dams on the Drin. These reservoirs significantly alter the river's natural flow regime, reducing seasonal variability and sediment transport. Despite regulation, Drini i Zi remains a key water resource for hydropower, irrigation, and regional water supply, and it contributes the largest share of total flow in the Drin-Buna system, making it central to Albania's water and energy infrastructure.
Molla e Lurës	Drini i Zi	The Molla e Lurës River is a small tributary draining a 150 km ² catchment into the Drini i Zi, and is influenced by the northern Mediterranean climate.
Murra	Drini i Zi	The Murra River drains a 150 km ² mountainous catchment before joining the Drini i Zi, and is under the influence of the northern Mediterranean climate.
Sela	Drini i Zi	The Sela River is a short tributary flowing from highlands with an 89 km ² catchment into the Drini i Zi, influenced by the northern Mediterranean climate.
Veleshica	Drini i Zi	The Veleshica River drains a 104 km ² alpine catchment and flows into the Drini i Zi, under the influence of the northern Mediterranean climate.
Zalli i Bulqizës	Drini i Zi	The Zalli i Bulqizës River is a larger tributary of the Drini i Zi, draining a 440 km ² catchment and shaped by the northern Mediterranean climate.
Bushtrica	Kaskada Drinit	The Bushtrica River is a high-altitude tributary within the Drin Cascade region, draining a 207.7 km ² catchment under the influence of the premountain Mediterranean climate. It merges with upstream waters of the Valbona River, contributing to the formation of its main stem.
Curraj	Kaskada Drinit	The Curraj River is a mountain tributary within the Drin Cascade region, draining a 152.8 km ² catchment into the Drin system. It flows through steep alpine terrain and is influenced by the northern Mediterranean climate, with moderately high and stable flows.
Dardhë	Kaskada Drinit	The Dardha River is a small mountain tributary in the Drin Cascade region, draining a 19 km ² catchment area. It flows into the Fierza Reservoir and is influenced by the northern Mediterranean climate, with very low but stable flows.
Drin	Kaskada Drinit	The Drini River forms the main stem of the Drin-Buna system, created by the confluence of the Drini i Zi and Drini i Bardhë near Kukës in northeastern Albania. From there, it flows westward through rugged terrain before entering the lowlands near Shkodra, ultimately merging with the Buna River. The river is heavily regulated by the Drin Cascade, the largest hydropower system in Albania, composed of three main reservoirs: Fierza (storage capacity 2.7 billion m³), Koman (0.5 billion m³), and Vau i Dejës (0.3 billion m³). These dams provide essential flow regulation, seasonal storage, and hydropower production, significantly modifying the river's natural regime. Downstream of Vau i Dejës, the Drin flows through the lowlands and is further exploited by the Ashta Hydropower Plant (53 MW), a run-of-river facility and the last stage of the cascade. Shortly after Ashta, the Drin joins the Buna River, which carries the combined flow to the Adriatic Sea. This confluence lies just below Lake Shkodra, in a flat and flood-prone zone often affected by backwater dynamics during high-flow periods. The Drin Cascade supplies over 90% of Albania's electricity demand and plays a crucial role in national water resources management, while also shaping the hydrology, sediment transport, and floodplain dynamics of the downstream Buna and coastal wetlands.

River Name	Subbasin	Brief description of the river
Drini i Bardhë	Kaskada Drinit	The Drini i Bardhë (White Drin) is one of the two main headwater branches of the Drin River, rising in the Zhleb mountains of western Kosovo, near the town of Pejë. It flows southwest through Kosovo, passing through the cities of Gjakovë and Rahovec, before entering northeastern Albania near the village of Zhur. With a total length of approximately 136 km, the river drains a catchment area of over 4,964 km ² , a portion of which lies in Albania. In its upper reaches in Kosovo, the Drini i Bardhë receives numerous tributaries, including the Lumbardhi i Pejës and Erenik rivers, and plays a vital role in irrigation, local water supply, and ecosystem support. Upon entering Albania, the river flows through steep terrain and eventually merges with the Drini i Zi to form the main Drin River, just upstream of the Fierza Reservoir. While less regulated than the Drini i Zi, the Albanian section of the Drini i Bardhë is still affected by the reservoir's backwater effects. The river is hydrologically important for both transboundary water cooperation and the integrated management of the wider Drin-Buna basin.
Gashi	Kaskada Drinit	The Gashi River is a high-altitude mountain tributary in the Drin Cascade region, draining a 110.5 km ² catchment. It flows through steep alpine terrain and joins the Valbona River, contributing to its upper reaches.
Gjadër	Kaskada Drinit	The Gjadër River is a medium-sized tributary within the Drin Cascade region, draining a 199.2 km ² catchment. It flows into the Drin immediately downstream of the Vau i Dejës hydropower plant, contributing to the regulated lower reach of the river system.
Gomsiqe	Kaskada Drinit	The Gomsiqe River is a tributary in the Drin Cascade region, draining a 142.3 km ² catchment. It flows from the southeast to the northwest, with its final discharge into the Vau i Dejës Reservoir.
Kalimashi	Kaskada Drinit	The Kalimashi River is a small tributary in the Drin Cascade region, draining a 35.95 km ² catchment. It flows through mountainous terrain and discharges directly into the Fierza Reservoir.
Kruma	Kaskada Drinit	The Kruma River is a small tributary in the Drin Cascade region, draining a 48.1 km ² catchment and flowing through hilly terrain. It discharges into the Fierza Reservoir.
Luma	Kaskada Drinit	The Luma River is a transboundary tributary in the Drin Cascade region, with its headwaters originating in Kosovo and a total catchment area of 181.7 km ² . It flows through mountainous terrain in northeastern Albania and discharges into the Fierza Reservoir.
Mashi	Kaskada Drinit	The Mashi River is a small tributary in the Drin Cascade region, draining a 28.1 km ² catchment and flowing through hilly terrain. It discharges into the Fierza Reservoir.
Sapaçi	Kaskada Drinit	The Sapaçi River is a small tributary in the Drin Cascade region, draining a 49.7 km ² catchment and flowing through mountainous terrain. It discharges into the Komani Reservoir.
Serriqe	Kaskada Drinit	The Serriqe River is a tributary in the Drin Cascade region, draining a 100.7 km ² catchment and flowing through rugged terrain. It discharges into the Fierza Reservoir and is influenced by a mix of northern mountainous and hilly Mediterranean climate conditions.
Shala	Kaskada Drinit	The Thethi–Shala River originates in the Albanian Alps, where it rises as the Thethi River in a remote high-mountain catchment above 866 m a.s.l., flowing through dramatic alpine valleys before becoming known as the Shala River downstream. Together they drain a rugged, largely natural landscape of steep slopes, karst features, and deep gorges across a ~135 km ² basin, with flows influenced by snowmelt and rainfall under a continental-alpine Mediterranean climate. The combined river eventually contributes to the Drin system, transporting clear, cold waters and sediments typical of high-elevation catchments.
Skatina	Kaskada Drinit	The Skatina River is a tributary in the Drin Cascade region, draining a 77.4 km ² catchment and flowing through steep, hilly terrain. It discharges into the Fierza Reservoir and is influenced by the northern hilly Mediterranean climate.
Valbona	Kaskada Drinit	The Valbona River is a pristine mountain tributary of the Drini i Bardhë, located in the northern Albanian Alps, within Valbona Valley National Park. It originates near the Çerem and Dobërdoll highland pastures, close to the Kosovo border, and flows southwest for about 50 km before joining the Drini i Bardhë near the town of Bajram Curri. The river drains a steep, rugged catchment of around 400 km ² , characterised by karstic formations, dense forests, and glacial valleys. Known for

River Name	Subbasin	Brief description of the river
		its clear turquoise waters, high ecological value, and seasonal snowmelt-fed flow regime, the Valbona supports rich aquatic biodiversity and is a key source of clean water in the region. Though largely unregulated, recent small-scale hydropower developments have raised concerns about its conservation.

CONCEPT

Table 15 - Drin-Buna River Basin - Waterbody Characterisation – Category LAKES.

Lake Name	Subbasin	EU Code	Altitude (abs)	Area (km ²)	Geology	Typology	Depth (m)	Lake form	Length (km)	Ecoregion	Δ level (m)
Murtema Lake	Drin-Bunë	LW3510101	0.89	1.08	Calcareous/mixed	L-01b	1.5	NWB	15.74	Hellenic western Balkan	1
Shkodra Lake	Drin-Bunë	LW3510201	5.48	159.79	Calcareous/mixed	L-01d	5	NWB	98.26	Hellenic western Balkan	2
Shtodri reservoir	Drin-Bunë	LW35103401	71.9	0.79	Calcareous/mixed	L-01a	25	AWB	7.55	Hellenic western Balkan	10
Fierza Lake	Kaskada e Drinit	LW3510701	284.9	54.95	Siliceous	L-07c	166.5	AWB	351.33	Hellenic western Balkan	55
Komani Lake	Kaskada e Drinit	LW3510301	172.25	11.93	Calcareous/mixed	L-01c	115.5	AWB	139.92	Hellenic western Balkan	14.5
Vau i Dejes Lake	Kaskada e Drinit	LW3510302	73.55	21.33	Siliceous	L-13c	30	AWB	128.32	Hellenic western Balkan	13.2
Great Prespa Lake	Oher - Prespa	LW3510902	844.15	45.76	Calcareous/mixed	L-03b	52.4	NWB	48.69	Hellenic western Balkan	5
Lake Ohëri	Oher - Prespa	LW3510903	693.2	108.49	Calcareous/mixed	L-02d	289	NWB	55.16	Hellenic western Balkan	0.65
Small Prespa Lake	Oher - Prespa	LW3510901	849.88	4.58	Calcareous/mixed	L-03b	4	NWB	13.02	Hellenic western Balkan	1
Murtema Lake	Drin-Bunë	LW3510101	0.89	1.08	Calcareous/mixed	L-01b	1.5	NWB	15.74	Hellenic western Balkan	1

Lake Name	Subbasin	Brief description of the lake
Liçeni i Prespës së Vogël	Oher - Prespa	The Prespa Lakes system consists of two linked tectonic lakes, Greater Prespa and Small Prespa, located at the intersection of Albania, North Macedonia, and Greece. Greater Prespa Lake lies at an elevation of approximately 850 m a.s.l., making it the highest tectonic lake in the Balkans, and has a surface area of around 259 km², of which roughly 45 km² lie within Albania. It has a maximum depth of about 55 m and a mean depth of around 18.8 m, with an estimated water volume of 4.8 billion m³. The lake's water balance is primarily influenced by direct precipitation, small tributaries, and subsurface losses, as it lacks any permanent surface outflow. Instead, water drains underground through karstic systems, most notably through the Devoll–Galičica karst, toward Lake Ohrid, located about 150 m lower in elevation. Small Prespa Lake, shared between Albania and Greece, lies slightly lower in elevation and covers a smaller area of about 47.4 km², of which 4.2 km² are in Albania. It is separated from Greater Prespa by a narrow isthmus but is hydrologically connected during high water periods. Both lakes are ecologically significant, forming part of a designated Ramsar site and Prespa Park, due to their high biodiversity, including endemic fish species and important wetland habitats for migratory birds. The Prespa basin is also notable for its fragile water balance. In recent decades, lake levels have fluctuated due to changes in climate, land use, and water abstraction, raising transboundary management concerns for long-term ecological protection.
Liçeni i Prespës së Madhe	Oher - Prespa	
Liçeni i Ohrit	Oher - Prespa	Lake Ohrid is one of the deepest and oldest lakes in Europe, located at the border between Albania and North Macedonia, within a tectonic-karstic basin. It covers a surface area of approximately 362 km², with about one-third lying in Albania, and reaches a maximum depth of 288 m. The lake's drainage basin covers around 1,365 km², and its long-term mean inflow is estimated at 6.5 m³/s, influenced both by precipitation and strong subsurface inflows from karstic springs, including inputs from Lake Prespa, which lies 150 m higher in elevation. Lake Ohrid discharges into the Black Drin River, forming a key part of the Drin Basin hydrological system. It is also renowned for its clear waters, thermal stratification, and good biodiversity, including many relict and endemic species, making it one of the most important limnological and ecological hotspots in Europe. Seasonal temperature variations range from 5.4°C in winter to about 21°C in summer, with surface temperatures reaching 23.8°C during summer months, while deeper layers remain near 7–8°C year-round, supporting a stable ecological environment.

Lake Name	Subbasin	Brief description of the lake
Liçeni i Fierzës	Kaskada e Drinit	Fierza Reservoir (Liçeni i Fierzës) is the largest artificial lake in Albania and a critical component of the Drin River Cascade. Constructed in 1978 for hydroelectric power generation, the reservoir lies at a maximum operating elevation of 2 m a.s.l. and is retained by the Fierza Dam, a 166.5 m high rockfill structure with a clay core, located on the Drin River. The dam has a crest length of 380 m and holds a body volume of 8 million m³. The total designed storage capacity of the reservoir is 2.7 billion m³, while the measured volume is around 2.19 billion m³. It covers a water surface area of over 61 km², receiving inflows from a catchment area of 11,829 km², including significant contributions from the Drini i Zi and Drini i Bardhë tributaries. The reservoir supports the Fierza hydropower plant, which has an installed capacity of 500 MW. The dam's spillway capacity reaches 2670 m³/s via two controlled spillways, and it is equipped with 4 bottom intake pipes (4 × 123.5 m³/s). The projected average inflow is 202 m³/s, while the maximum daily inflow measured in 2021 reached 2380 m³/s, reflecting the reservoir's vital role in seasonal flood regulation. The dam and reservoir are monitored through a comprehensive system including hydrological, geodetic, seismic, and hydraulic monitoring equipment, with 9 piezometers on the dam and 15 on its slopes. Notably, the population at potential risk downstream is estimated at 195,600 people, underscoring the importance of robust dam safety management and continuous monitoring.
Liçeni i Vaut të Dejës	Kaskada e Drinit	Lake Vau i Dejës is the lowest reservoir in the Drin River Cascade, formed by the confluence of three dams—Qyrsak, Zadeja, and Rragami—completed in 1971 to support hydroelectric generation at the HEPP Vau i Dejës. The main dam structure is a rockfill dam with a clay core, with the Zadeja Dam reaching a height of 60 m and a crest length of 387 m, and the Qyrsak Dam integrating both rockfill and concrete gravity sections, with a crest length of 514 m. Collectively, these structures retain a designed reservoir volume of 580 million m³, while the measured volume is 499 million m³, covering a maximum water surface area of 21.4 km². The reservoir operates between water levels of 63.0 m and 76.2 m a.s.l., and it collects runoff from a substantial 14,173 km² catchment area. The average projected inflow into the reservoir is 310 m³/s, with the maximum measured daily inflow reaching 709 m³/s, reflecting its key role in both energy production and flood regulation. The hydropower plant at Vau i Dejës has an installed capacity of 250 MW, and the entire system is equipped with comprehensive monitoring infrastructure, including geodetic, hydrological, and seismic instrumentation. The project is of strategic importance not only for energy generation but also due to the 195,600 people at potential flood risk in the downstream area, making the integrity and ongoing monitoring of the dam system a top priority.
Liçeni i Komanit	Kaskada e Drinit	Lake Koman is the second major reservoir of the Drin River Cascade and a central element of Albania's hydroelectric infrastructure. Created by the Koman Dam in 1986, it is located downstream of Fierza and upstream of Vau i Dejës. The dam itself is a concrete face rockfill structure, with a height of 115.5 m and a crest length of 275 m, retaining a body volume of over 5.7 million m³. The reservoir stretches through narrow, steep-sided valleys, covering a maximum surface area of 12.15 km², and receiving water from a 12,850 km² catchment area. Its designed storage volume is 500 million m³, while the measured maximum volume is approximately 432 million m³, and the operational water level ranges between 161 m and 175.5 m a.s.l. The dam operates with 4 intake pipes (4 × 184 m³/s) and two controlled spillways capable of handling a total spillway discharge of 3600 m³/s. The average annual inflow to the reservoir is estimated at 289 m³/s, and the maximum daily inflow, measured in recent years, reaches 1550 m³/s. The associated HEPP Koman has an installed power capacity of 600 MW, making it the largest among the cascade's plants. The dam is equipped with a comprehensive monitoring system, including geodetic, hydrogeologic, hydrometeorological, seismic, and hydraulic instrumentation, ensuring the safety of both the infrastructure and the estimated 196,400 people in the risk zone downstream.
Liçeni i Murtemës	Drin-Bune	Lake Murtema (Liçeni i Mërtremës) is a small natural lake in the Drin–Buna sub-basin, located at an elevation of about 0.9 m a.s.l. and covering approximately 1.08 km². With a maximum depth of 1.5 m, it is classified as a natural water body (NWB) within the Hellenic Western Balkan ecoregion. The lake plays a role in floodplain hydrology and is likely influenced by groundwater and seasonal inundation processes typical of the lower Drin–Buna system. The area around Lake Murtemës is almost entirely covered with farmland, reflecting its integration into a landscape shaped by agriculture and riverine dynamics.

Lake Name	Subbasin	Brief description of the lake
Liçeni i Shkodrës	Drin-Bune	Lake Shkodra (also known as Lake Skadar) is the largest lake in the Balkans, with a surface area of approximately 452 km², of which 183 km² lie in Montenegro and the remainder in Albania. It lies in a tectonic basin filled with alluvial sediments and is fed by numerous rivers including the Morača, Zeta, Cemi, Kir, and Përroi i Thatë. The lake has an average depth of 7 m, a maximum depth of 44 m, and stores an estimated 2.6 billion m³ of water under average conditions. Its only surface outlet is the Buna River, which drains southwards into the Adriatic and also receives overflow from the Drin during high-flow events. The hydrological regime of Lake Shkodra is highly seasonal, with peak runoff in winter and spring, accounting for over 70% of total annual discharge. The lake is fed by underground and submarine karstic springs and receives an average of 2,170 mm of precipitation annually. Only 6% of its water loss is due to evaporation, with 94% exiting through the Buna River, highlighting its role as a natural regulator of river discharge, especially during flood and drought periods. Its hydrographic basin covers around 5,175 km², about two-thirds of which lie within Albania, and it is ecologically significant, supporting wetland habitats of international importance and serving as a Ramsar-designated site.
Ujëmbledhësi i Shtodrit	Drin-Bune	The Shtodri Reservoir (Ujëmbledhësi i Shtodrit) is an artificial lake located near the city of Shkodra, within the Drin–Buna sub-basin, at an elevation of 71.9 m a.s.l.. Constructed between 1969 and 1975, the reservoir was designed primarily for irrigation purposes and has a total storage capacity of 11 million m³. Its water surface covers approximately 100 hectares (1.0 km²), and it is retained by an earthen dam with a height of 30 m and a crest length of 475 m. Water is supplied partly from the local catchment and partly via a derivation canal from the Kir River, with a maximum intake flow of 1.2 m³/s. The reservoir plays a vital role in regional agriculture by supporting the irrigation of 3,400 hectares of farmland in the Mbishkodra area, contributing to the socio-economic development of this lowland region.

Table 16 - Drin-Buna River Basin - Waterbody Characterisation – Category TRANSITIONAL WATERS.

Name	Subbasin	EU Code	Form	Length (km)	Annual Salinity (‰)	Electrical conductivity (mS/cm)	Mean tidal range	Mean water temperature (°C)	Ecoregion	Turbidity (g/m ³)
Buna River	Drin-Bunë	TW3510101	HMW B	4.37	30–40 ‰ euhaline	42.5mS/cm	< 2 microtidal	12.2	Hellenic western Balkan	
LDrini i Lezhës River	Drin-Bunë	TW3511101	HMW B	3.25	30–40 ‰ euhaline	42.5mS/cm	< 2 microtidal	13.2	Hellenic western Balkan	
Merxhani Lake	Drin-Bunë	TW3511102	NWB	16.16	30–40 ‰ euhaline	57.6 mS/cm	< 2 microtidal	20	Hellenic western Balkan	
Viluni Lagoon	Drin-Bunë	TW3510102	NWB	22.18	30–40 ‰ euhaline	57.6 mS/cm	< 2 microtidal	18	Hellenic western Balkan	

Table 17 - Drin-Buna River Basin - Waterbody Characterisation – Category COASTAL WATERS.

Name	Subbasin	EU Code	Form	Length (km)	Annual Salinity (‰)	Mean depth (m)	Mean tidal range (m)	Mean water temperature (°C)	Turbidity (g/m ³)	Ecoregion
Grykëderdhja Bunë	Drin - Bunë	CW3510101	NWB	6.137485	30–40 ‰ euhaline	10	<2 m: microtidal	17.8 ° C	15 g/m ³	Mediterranean Sea
Ishull-Lezha	Drin - Bunë	CW3511102	NWB	8.15528	30–40 ‰ euhaline	5	<2 m: microtidal	17.8 ° C	15 g/m ³	Mediterranean Sea
Shëngjin	Drin - Bunë	CW3511101	NWB	10.66849	30–40 ‰ euhaline	12	<2 m: microtidal	17.8 ° C	15 g/m ³	Mediterranean Sea

Velipojë-Mali Rrencit	Drin - Bunë	CW3510102	NWB	16.72383	30–40 ‰ euhaline	15	<2 m: microtidal	17.8 °C	15 g/m3	Mediterranean Sea
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Table 18 - Drin-Buna River Basin - Waterbody Characterisation – Category HEAVILY MODIFIED WATERBODIES (HMWB) and ARTIFICIAL (AWB)⁸⁰.

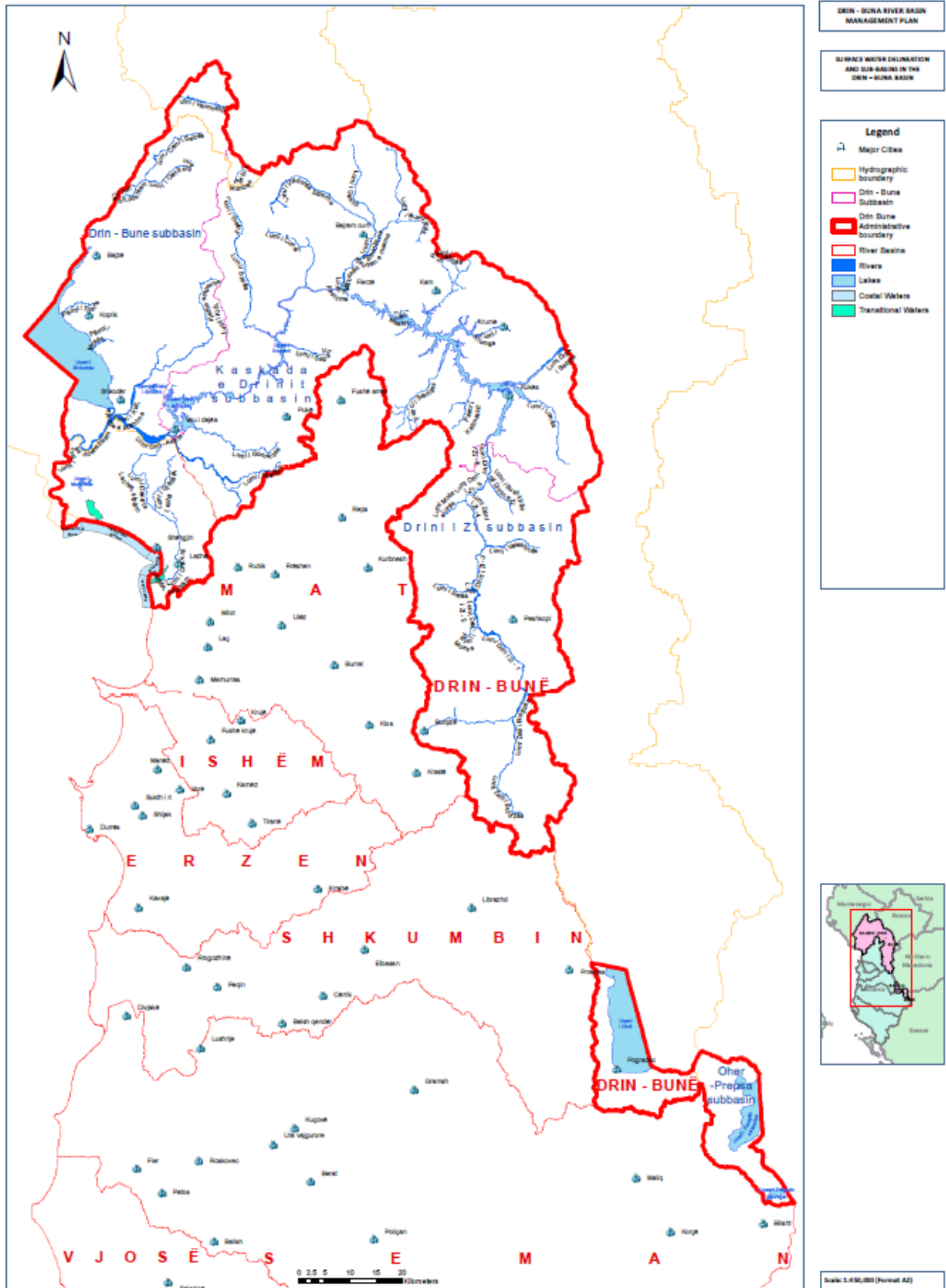
AWB or HMWB name	Sub-basin	Swb EU Code	Ecstatus Category	Form	Typology EU Code	Length km	Area km ²	HMWB/AWB Alteration	HMWB/AWB use
Buna River	Drin - Bunë	35101	RW	HMW B		36.9	68.92	Channelisation - Reinforcement/ Flow regime	Agriculture - irrigation/Flood protection
Drini i Lezhës River	Drin - Bunë	35111	RW	HMW B		22.1	286	Channelisation - Reinforcement/ Flow regime	Agriculture - irrigation
Drini i Lezhës River	Drin - Bunë	35112	RW	HMW B		21.8	58	Channelisation - Reinforcement/ Flow regime	Agriculture - irrigation
Shtodri reservoir	Drin-Bunë	LW351034 01	LW	AWB		7.5	0.79	Weirs – Dams – Reservoir	Agriculture - irrigation/Tourism&recreation
Drini i Zi River	Drini i Zi	351091	RW	HMW B		7.5	43	Flow regime/	Agriculture - irrigation
Drini i Zi River	Drini i Zi	351095	RW	HMW B		10.6	133	Flow regime	Agriculture - irrigation
Drini i Zi River	Drini i Zi	351099	RW	HMW B		7.5	117	Flow regime	Agriculture - irrigation
Drini i Zi River	Drini i Zi	3510931	RW	HMW B		7.5	49	Flow regime	Agriculture - irrigation
Drini i Zi River	Drini i Zi	3510933	RW	HMW B		11.1	63	Flow regime	Agriculture - irrigation
Drini i Zi River	Drini i Zi	3510971	RW	HMW B		10.1	103	Flow regime	Agriculture - irrigation
Drini i Zi River	Drini i Zi	3510973	RW	HMW B		22	267	Flow regime	Agriculture - irrigation
Drin River	Kaskada Drinit	3510321	RW	HMW B		18.5	28.84	Dams / reservoirs/Flow regime	Hydropower
Drini i Bardhë River	Kaskada Drinit	351082	RW	HMW B		6.7	62.82	Flow regime	Hydropower
Drini River	Kaskada Drinit	351031	RW	HMW B		1.8	0.66	Dams / reservoirs/Flow regime	Hydropower
Komani Lake	Kaskada e Drinit	LW351030 1	LW	AWB		139.9	11.93	Dams / reservoirs/Flow regime	Hydropower

⁸⁰ Notes:

1. Comparable Category means the waterbody category which the AWB or HMWB most closely resembles for ecological potential assessment
2. Alteration is from WISE 2016 GIS schema SWB: <HMWB Physical Alteration>
3. Use is from WISE 2016 GIS schema SWB: <HMWB Water Use>
4. Exemption Type is from WISE 2016 GIS schema SWB.
5. Exemption Types are INDICATIVE only. Justification must be confirmed in the Economic Analysis.
6. If Exemption Type is listed as Article 4(7) New Modification, Date of new modification must be provided, and justification must be confirmed in the Economic Analysis.
7. HMWB/AWB use is defined under WISE Reporting.

Lake Fierza	Kaskada e Drinit	LW351070 1	LW	AWB		351.3	54.95	Dams / reservoirs/Flow regime	Hydropower
Vaut Dejës Lake	Kaskada e Drinit	LW351030 2	LW	AWB		128.3	21.33	Dams / reservoirs/Flow regime	Hydropower/Agriculture-irrigation

CONCEPT



Map 3 - Buna River Basin - Surface Waterbody Category and Delineation.

7.4 Transboundary Surface Water Bodies

7.4.1 Introduction

The Drin-Buna River Basin is one of the most complex transboundary hydrological systems in South-Eastern Europe. The wider basin extends across Albania, Kosovo, Montenegro, North Macedonia and Greece and includes interconnected rivers, lakes, aquifers, wetlands and coastal waters. These water systems support more than 1.6 million people and provide important services for water supply, hydropower, irrigation, fisheries, biodiversity, flood retention, tourism and regional development.

Within the Albanian part of the Drin-Buna River Basin, several surface water bodies are transboundary. These water bodies either enter Albania from neighbouring countries, flow from Albania into neighbouring countries, or are shared lakes crossing national borders. Their hydrological, ecological and chemical status is influenced by pressures and management decisions in more than one jurisdiction. For this reason, they require coordinated monitoring, comparable assessment methods, regular data exchange and joint management in line with WFD Articles 3 and 13.

Transboundary cooperation in the basin is supported by the Drin Memorandum of Understanding, signed in 2011, and by the Strategic Action Programme endorsed in 2020 by the five riparians. These instruments provide the basis for coordinated management of shared waters, supported by the Drin Core Group, expert working groups, UNECE, GEF and GWP-Mediterranean. Bilateral agreements complement this basin-wide framework, including cooperation between Albania and Montenegro on Lake Shkodër/Skadar, the Buna/Bojana and Cemi/Cijevna rivers, and cooperation between Albania and North Macedonia on Lake Ohrid.

7.4.2 Transboundary Rivers

Seven river water bodies in the Drin-Buna Basin cross international boundaries. The most important are the Buna/Bojana, Drini i Zi, Drini i Bardhë and Cemi/Cijevna. Smaller transboundary water bodies include the Vermoshi, Luma and Runica.

Table 19 - Transboundary river water bodies of the Drin-Buna basin.

River	Sub-basin	Shared with	Direction	Length (km)	Mean Q (m³/s)
Buna/Bojana	Drin – Bunë	Montenegro	Outflow	41	320
Drini i Zi (Black Drin)	Drini i Zi	North Macedonia	Inflow	149	70–80
Drini i Bardhë (White Drin)	Kaskada Drinit	Kosovo	Inflow	136	60–70
Cemi/Cijevna	Drin – Bunë	Montenegro	Outflow	65	15–25
Vermoshi	Danub	Montenegro	Outflow	10.3	7
Luma	Kaskada Drinit	Kosovo	Inflow	19.6	11
Runica	Danub	Montenegro	Outflow	0.76	2

The **Buna/Bojana River** is the final outlet of the Drin-Shkodër system to the Adriatic Sea. It originates from Lake Shkodër near the city of Shkodra and receives the Drin through the Drinasa channel. The river is approximately 41 km long and forms part of the Albania-Montenegro border in its lower reaches. With a long-term mean discharge of about 320 m³/s, it is one of the major freshwater inputs to the Mediterranean. The Buna/Bojana delta and surrounding wetlands have high ecological value and are recognised as internationally important wetland systems. Key management issues include flood risk, sediment transport, water quality and wetland protection. These issues require close cooperation between Albania and Montenegro.

The **Drini i Zi / Black Drin** originates as the outflow of Lake Ohrid near Struga in North Macedonia and enters Albania before joining the White Drin near Kukës. It is one of the main headwater branches of the Drin system and contributes a large share of the total flow entering the Albanian Drin Cascade. Upstream hydropower regulation in North Macedonia modifies the natural flow regime and sediment transport entering Albania. In Albania, the Black Drin receives several tributaries and is impounded by Fierza Reservoir, the largest reservoir in the Drin Cascade. Transboundary management should focus on flow regulation, hydropower coordination, water quality and ecological flow requirements.

The **Drini i Bardhë / White Drin** rises in western Kosovo and flows towards Albania, where it joins the Black Drin upstream of Fierza Reservoir. The river supports irrigation, local water supply and ecosystems in Kosovo and is also connected to shared karstic groundwater systems. In Albania, the river is influenced by the backwater effects of Fierza Reservoir. Main transboundary concerns include nutrient and pathogen loads, groundwater management, waste-related pressures and coordinated monitoring between Albania and Kosovo.

The **Cemi/Cijevna River** originates in northern Albania and flows into Montenegro, where it joins the Morača system and ultimately Lake Shkodër/Skadar. It has high ecological and recreational value and includes steep mountain and canyon sections. The river has received specific transboundary attention because of concerns about small hydropower development in Albania and possible downstream effects in Montenegro. Albania and Montenegro have strengthened cooperation through advisory support under the UNECE Water Convention, including information exchange, joint monitoring and technical working arrangements.

The **Vermoshi** and **Runica** water bodies are located in the far north of Albania. Although administratively included in the Drin-Buna Basin, they drain towards Montenegro and belong hydrologically to the Danube Basin and ultimately the Black Sea drainage system. They are small mountain water bodies with transboundary relevance for monitoring and regional water management. The **Luma River** enters Albania from Kosovo and discharges into Fierza Reservoir. Its water quality and sediment load are relevant for reservoir management and downstream hydropower operation.

7.4.3 Transboundary Lakes

The Drin-Buna Basin includes four major transboundary lakes: Lake Shkodër/Skadar, Lake Ohrid, Great Prespa Lake and Small Prespa Lake. Together, these lakes form one of Europe's most important chains of interconnected freshwater ecosystems. They are linked by surface water and karst groundwater pathways: the Prespa Lakes drain underground towards Lake Ohrid, Lake Ohrid discharges into the Black Drin, and Lake Shkodër drains through the Buna/Bojana to the Adriatic Sea.

Table 20 - Transboundary lake water bodies of the Drin-Buna basin.

Lake	Sub-basin	Shared with	Total area (km ²)	Max depth (m)	Area in Albania (km ²)	Designation
Lake Shkodra/Skadar	Drin-Bunë	Montenegro	452	44	~160	Ramsar Site
Lake Ohrid	Oher-Prespa	North Macedonia	358	288	~108	UNESCO WHS
Great Prespa Lake	Oher-Prespa	North Macedonia, Greece	259	55	~46	Ramsar Site
Small Prespa Lake	Oher-Prespa	Greece	47.4	4	~4.6	Ramsar Site

Lake Shkodër/Skadar, shared by Albania and Montenegro, is the largest lake in the Balkans. It is a lowland lake with strong seasonal water-level variation and a key role in regulating flows in the lower Drin-Buna system. It receives inflows from rivers and karstic springs and drains only through the Buna River. During high-flow events, interactions between the Drin, Lake Shkodër and the Buna can strongly influence flooding in the lower basin. The lake supports extensive wetlands, submerged and floating vegetation, fish populations and large numbers of birds. It is designated as a Ramsar Site by both Albania and Montenegro, and the Montenegrin part is also a National Park.

Lake Ohrid, shared by Albania and North Macedonia, is one of Europe's oldest and deepest lakes. It lies in a tectonic-karstic basin and receives inflow from direct precipitation, local catchments and major karstic springs, including subsurface inflow from the Prespa system. Lake Ohrid discharges into the Black Drin and therefore forms a key hydrological link between the Ohrid-Prespa system and the downstream Drin Cascade. The lake is internationally recognised for its oligotrophic character, exceptional biodiversity and high number of endemic species. It is protected through UNESCO World Heritage status and bilateral cooperation between Albania and North Macedonia. Main pressures include urban development, wastewater, tourism, invasive species and the need to preserve its oligotrophic status.

The **Prespa Lakes**, shared by Albania, North Macedonia and Greece, form the uppermost part of the wider Drin hydrological system. Great Prespa Lake has no permanent surface outflow and drains mainly through karstic pathways towards Lake Ohrid. This underground connection means that changes in water quantity and quality in Prespa may influence Lake Ohrid and, through the Black Drin, the downstream Drin system. Small Prespa Lake is a shallow wetland lake shared by Albania and Greece. Both lakes are ecologically important, support endemic species and wetland habitats, and form part of the Prespa Park, the first transboundary protected area in the Balkans. Water-level fluctuations, climate variability, land use change and abstraction pressures are important management concerns.

7.4.4 Institutional Framework for International Cooperation

The management of transboundary surface water bodies in the Drin-Buna Basin is supported by a multi-level institutional framework. At basin scale, the Drin Memorandum of Understanding and the Strategic Action Programme provide the main cooperation framework. The Strategic Action Programme identifies priority actions related to water pollution, biodiversity degradation, water flow disturbance and sediment flow disturbance. A new implementation phase launched in 2025 aims to strengthen joint monitoring, legal cooperation, biodiversity protection, energy-water coordination and climate adaptation.

At bilateral level, cooperation instruments address specific shared waters. Albania and Montenegro cooperate on Lake Shkodër/Skadar, the Buna/Bojana and Cemi/Cijevna systems. Albania and North Macedonia cooperate on Lake Ohrid and its watershed. Albania, North Macedonia and Greece cooperate through the Prespa Park framework. These arrangements are supported by the UNECE Water Convention, to which the riparian states are Parties.

For the Drin-Buna RBMP, transboundary surface water bodies require specific attention in monitoring, classification, pressure assessment, environmental objectives and Programme of Measures design. The RBMP should ensure that Albania's national measures are aligned, where relevant and feasible, with neighbouring countries. Priority should be given to shared monitoring, harmonised assessment methods, exchange of hydrological and water-quality data, coordinated management of hydropower and environmental flows, protection of transboundary lakes and wetlands, and joint responses to flood, drought, pollution and sediment-management issues.

7.5 Characterisation and Delineation of Groundwater Bodies

7.5.1 Overview

This section describes the delineation, characterisation, and assessment of groundwater bodies (GWBs) in the Drin-Buna River Basin. It follows the requirements of the EU WFD (WFD 2000/60/EC), the Groundwater Directive (2006/118/EC), the Nitrates Directive (91/676/EEC), and the relevant CIS Guidance Documents No. 2, No. 15, and No. 18.

Groundwater bodies form the basic management units for characterising groundwater resources and reporting groundwater status under the WFD. The delineation approach aims to define each groundwater body as a coherent hydrogeological unit in terms of natural characteristics, pressures, and impacts. This supports effective monitoring, risk assessment, and the identification of management measures within the RBMP cycle.

The RBMP must provide an initial characterisation of all groundwater bodies. This characterisation assesses current uses and determines whether groundwater bodies are at risk of failing the WFD environmental objectives. These objectives are good quantitative status and good chemical status. Groundwater bodies identified as being at risk require further characterisation, including more detailed assessment of pressures, pathways, and receptors. This enables a more precise assessment of risk and supports the identification of measures needed to achieve compliance with WFD objectives.

In Albania, the Albanian Geological Survey (AGS) is the main competent authority for identifying, assessing, and reporting on groundwater resources trends, and impacts. AGS implements the annual national groundwater surveillance monitoring programme on behalf of the National Environment Agency (NEA). AGS activities are therefore linked to NEA through monitoring and reporting obligations, and to

the Water Resources Management Agency (WRMA / AMBU) through groundwater permitting and resource allocation. This institutional cooperation is essential for meeting monitoring requirements and supporting water allocation policies.

The WFD aims to prevent further deterioration and progressively improve the status of aquatic ecosystems. This includes safeguarding the water needs of terrestrial ecosystems that depend directly on groundwater. Protecting and restoring groundwater status is therefore an integral part of achieving the wider ecological objectives of the Directive.

7.5.2 Categorisation and Typology of Groundwater Bodies

Unlike surface waters, groundwater is not classified into multiple ecological categories. The WFD distinguishes between groundwater, aquifers, and groundwater bodies. Groundwater includes all water located beneath the land surface. Aquifers are geological strata with sufficient porosity and permeability to allow significant abstraction. Groundwater bodies are distinct volumes or zones of groundwater within recognised aquifers, delineated for management under the Directive.

The WFD applies a functional test to determine whether a groundwater resource qualifies as an aquifer for management purposes. The resource must be able to yield more than 10 m³ per day or supply at least 50 persons, or abstraction from the resource must have a significant impact on the ecological status of a surface water body or a groundwater-dependent terrestrial ecosystem.

For reporting and management, the minimum size of a groundwater body is normally 10 km², in line with the minimum catchment area used for surface water bodies under WFD Annex II. Smaller units may be delineated where specific management is required, for example to protect groundwater-dependent ecosystems or drinking water supplies for more than 50 persons.

Groundwater typology is based mainly on hydrogeological and geochemical characteristics. Unlike surface water typology, it does not rely on altitude or size descriptors. Instead, it reflects the geological formation and hydraulic behaviour of aquifer systems. The main hydrogeological types are porous aquifers, karstic aquifers, and fissured aquifers. Porous aquifers usually consist of unconsolidated alluvial or fluvio-glacial sediments with intergranular flow. Karstic aquifers occur in carbonate formations, such as limestone and dolomite, and show conduit and fissure flow with high variability and high vulnerability to pollution. Fissured aquifers occur in consolidated rocks where groundwater storage and movement take place mainly through fractures.

From a geochemical perspective, aquifers may be calcareous, siliceous, or organic/humic. These characteristics influence natural groundwater chemistry, buffering capacity, vulnerability to pressures and the natural background levels of substances. They are therefore important for defining reference conditions and assessing pressures and impacts.

Albania applies groundwater types that correspond broadly with EU WISE reporting categories. These include intergranular aquifers with high or medium productivity, fissured aquifers with medium to low productivity, fissured or karstified aquifers with high productivity, porous/fissured formations with medium or medium-low productivity, practically non-aquiferous rocks and unknown formations.

Table 21 - Principal Groundwater Types in Albania Reporting.

ALBANIA CODE	ALBANIA REPORTING GEOLOGICAL FORMATION ⁸¹	EQUIVALENT WISE REPORTING GEOLOGICAL FORMATION ⁸²
1	Intergranular porosity – high productivity	Porous – highly productive
2	Intergranular porosity – medium productivity	Porous - moderately productive
3	Fissured porosity – medium to low productivity	Fissured aquifers – moderately productive

⁸¹ Albanian Geological Service – 1:200 000 Hydrogeological Map of Albania, 2015. Tabulations of aquifer Types in Albania reporting is inconsistent between the 1:200 000 map and the GIS .shp files. The GIS .shp Type definitions have been used as the delineation type.

⁸² WFD – WISE GIS Reporting Guidance 2016 – schema GWB – schema element – *Geological Formation*

4	Fissured/karstified porosity – high productivity	Fissured aquifers including karst – highly productive
5	Porous/fissured porosity – medium productivity	Unclassified ⁸³
6	Practically non-aquiferous rocks	Insignificant aquifers – limited groundwater
7	Porous/fissured porosity - medium to low productivity	Unclassified
8	Not available or Unknown	Unknown

As with surface water bodies, a groundwater body must function as a coherent sub-unit within the river basin. The WFD objectives must be applicable to the groundwater body in a consistent way. In some cases, an entire aquifer may be designated as one groundwater body, but only where it is sufficiently homogeneous in hydraulic properties, natural chemistry, pressures, and impacts.

Further delineation of aquifers into discrete groundwater bodies must take account of groundwater flow divides and natural chemistry. Where hydrogeological data are limited, surface water catchments and geological boundaries may be used as proxies. Natural geochemical differences are relevant where they influence suitability for drinking water abstraction, vulnerability to pressures or the design of management measures.

The delineation of groundwater bodies in Albania therefore relies on identifying hydrogeological units, such as alluvial plains, karst systems, and fractured bedrock aquifers, assigning these units to the relevant typological classes, and establishing their relationship with dependent surface waters and terrestrial ecosystems. In GIS, groundwater body classification is implemented through a structured system that combines geological, hydrogeological, and morphological characteristics.

7.5.3 Delineation Principles

Aquifers with significantly different water-bearing properties must be separated by delineation boundaries. The main criteria are porosity, permeability, and resource potential. This process is relatively straightforward for homogeneous, unconfined aquifers, but more complex for three-dimensional geological formations with variable structure and lithology.

These geological complexities influence the yield capacity of groundwater bodies, their vulnerability to pollution and their hydraulic connectivity with associated surface water systems. Delineation must therefore reflect both the natural hydrogeological setting and the pressures and impacts acting on the groundwater system.

As for surface waters, the delineation of groundwater bodies must support accurate assessment of quantitative and chemical status. Where a single aquifer shows significant localised pollution, it may need to be subdivided into separate groundwater bodies to reflect different chemical status. The same principle applies where intensive abstraction creates local pressure on groundwater levels. Pumping can form a cone of depression and change the quantitative status of part of an aquifer. The affected area may therefore need to be delineated as a separate groundwater body, even where it forms part of a larger contiguous aquifer.

Delineation must also consider interactions with surface waters and dependent ecosystems. Where abstraction reduces groundwater discharge to rivers, weakens hydraulic connection, reduces spring flow, or changes interaction with wetlands or lakes, the groundwater body may need to be subdivided. In line with CIS Guidance No. 2, a groundwater body should be subdivided where a significant change in quantitative status alters flow patterns or impairs dependent ecosystems.

The final stage of groundwater body delineation is therefore iterative. It assesses anthropogenic pressures and impacts across aquifers in order to distinguish different degrees of status within the same hydrogeological unit. This is necessary to ensure that groundwater quality does not deteriorate and remains suitable for drinking water abstraction, dependent ecosystems, agricultural and industrial uses, and the maintenance of good ecological status in connected surface waters.

⁸³ The Albania definition of “porous/fissured porosity” does not coincide with EU WISE categories.

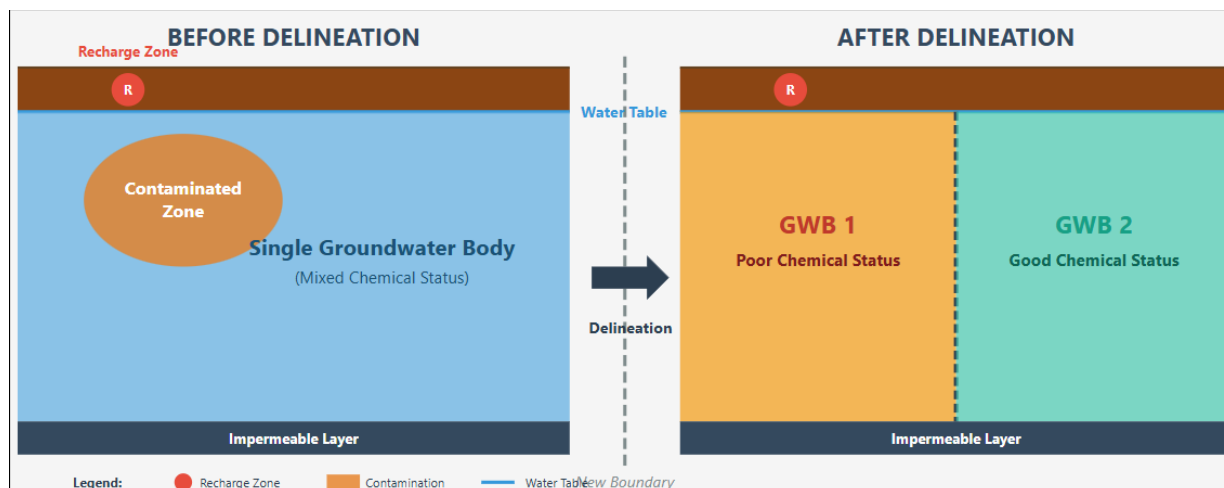


Figure 21 - Groundwater body delineation arising from change in chemical status.

7.5.4 Assessment and Coding of Groundwater Bodies

The principal hydrogeological formations in Albania are based on data from the Albanian Geological Service and published through the ASIG portal and NEA sources. Groundwater occurs in formations ranging from the Quaternary to the Palaeozoic. In the Albanian mountains, the geological structure typically includes carbonate and karstic formations, such as limestone. Highly permeable gravel aquifers also occur in lowland areas. Both carbonate karst systems and permeable gravel aquifers form highly productive aquifers and are widely present in the Drin-Buna River Basin.

A preliminary identification of groundwater bodies in Albania was conducted by AGS and international experts in 2008. This work identified five major hydrogeological formations and delineated 55 groundwater bodies across Albania. However, the CEMSA 2008 characterisation had several limitations. It did not sufficiently subdivide major regional aquifers into smaller groundwater bodies based on abstraction pressures, pollution status, or groundwater-dependent terrestrial ecosystems. These are fundamental tests for distinguishing a specific groundwater body from a wider aquifer.

Groundwater bodies should be coded in line with the principles of the EU WFD and the reporting logic of the Water Information System (WISE) for Europe (see textbox). A groundwater body is a distinct volume of groundwater within one or more aquifers and should therefore be identified as a management, assessment and reporting unit. The code should not refer to a spring, well, lithological unit, monitoring point or temporary map interpretation.

The 2008 work has been superseded by more detailed information from the 1:200,000 Hydrogeological Map of Albania, published in 2015. This map provides the basis for a more detailed identification of potential groundwater bodies within the new Albanian RBMP reporting framework. In the current RBMP phase, identification and reporting of groundwater body attributes aim to align more closely with the EU WISE reporting schema. The principal hydrogeological types used in this RBMP therefore follow the updated reporting framework rather than the earlier CEMSA 2008 classification.

For the Drin-Buna Basin, the recommended coding structure is: **AL_GWB_DB_001**

where **AL** refers to Albania, **GWB** to Groundwater Body, **DB** to the Drin-Buna Basin, and **001** to the unique sequential number of the groundwater body within the basin. The numbering should continue sequentially for all groundwater bodies identified in the basin. To ensure consistency and GIS traceability, the numbering should preferably follow the geographical position of the groundwater bodies, starting in the north-western part of the basin, continuing eastwards, and then moving gradually southwards.

The main groundwater body code should remain simple, unique and stable over time. Aquifer type and groundwater potential should not be included in the main code, because these are thematic characteristics that may change as hydrogeological knowledge, monitoring data and scientific interpretation improve. Instead, these characteristics should be stored as separate attributes in the GIS and reporting database.

The recommended attribute table should include the groundwater body code, basin code and basin name, as well as separate fields for aquifer type, aquifer type code, groundwater potential, groundwater potential code and map class. Aquifer type may be recorded as **Porous (P)** or **Compact rocks (C)**. Groundwater potential may be recorded as **High (H)**, **Medium (M)**, **Low (L)** or **Very Low (VL)**. Map classes can then be created by combining these attributes, for example **P_H**, **P_M**, **C_L** or **C_VL**.

This approach ensures that each groundwater body has a clear and stable identifier, while hydrogeological characteristics remain updateable in the attribute table. It supports map production, GIS analysis, monitoring, linkage with sampling points and future WFD reporting. For the Drin-Buna RBMP, the recommended approach is therefore to use unique groundwater body codes of the form **AL_GWB_DB_001**, with aquifer type, groundwater potential and map class stored separately.

7.5.5 Groundwater Bodies in the Drin-Buna River Basin

Reliable data on groundwater quality, quantitative status, pressures, and impacts remain limited for many groundwater bodies in Albania. The first-pass delineation for the 2022–2027 planning cycle therefore relies substantially on expert judgement. Nevertheless, the breakdown into smaller groundwater body units based on anticipated abstraction pressures, pollution levels and dependent terrestrial ecosystems represents a significant step towards a more structured and analytical approach to groundwater management.

In the Drin-Buna River Basin, a total of **120 groundwater bodies** has been classified and categorised. Of these, **44 groundwater bodies** belong to intergranular formations, and **76 groundwater bodies** belong to compact rocks. They are reported in separate tables according to formation type, either intergranular or compact, and according to water-bearing capacity: high, moderate, low, or very low.

Several groundwater bodies are transboundary between adjacent river basins. Groundwater management regimes must therefore take these transboundary connections into account. This is necessary to ensure coherent monitoring, consistent assessment, and effective management across river basin boundaries.

Table 22 - Aquifers in intergranular formations with high productivity.

No.	District	Aquifer type	Rock type	Lithology	Age	GWB_Code	Code	Surf. km ²
1	Diber	Porous	Sedimentary	Sand, gravel, clay	Qh	Kalis_Fushe-Muhur	GWB013	17.16832
2	Lezhe	Porous	Sedimentary	Sand, gravel, clay	Qh	Ishull-Lezhe	GWB006	12.25504
3	Lezhe	Porous	Sedimentary	Sand, gravel, clay	Qh	Shengjin	GWB008	4.921638
4	Lezhe	Porous	Sedimentary	Sand, gravel, clay	Qh	Shengjin	GWB009	4.167
5	Shkoder	Porous	Sedimentary	Sand, gravel, clay	Qh	Dobraç	GWB002	96.11928
6	Shkoder	Porous	Sedimentary	Sand, gravel, clay	Qh	Kamice-Sterbeqi	GWB010	20.77679
7	Shkoder	Porous	Sedimentary	Sand, gravel, clay	Qh	Pentar-Pulaj	GWB004	5.945763

8	Shkoder	Porous	Sedimentary	Sand, gravel, clay	Qh	Başallek	GwB015	9.164207
9	Shkoder	Porous	Sedimentary	Sand, gravel, clay	Qh	Selca	GWB012	3.37341
10	Lezhe	Porous	Sedimentary	Sand, gravel, clay	Qh	Manatia	GWB007	9.00529
11	Shkoder	Porous	Sedimentary	Clay, sand, gravel	Qp-h	Oblika	GWB036	6.888143
12	Shkoder	Porous	Sedimentary	Clay, sand, gravel	Qh	Tamar-Hot	GWB034	16.14628

Table 23 - Aquifers in intergranular formations with moderate productivity.

No.	District	Aquifer type	Rock type	Lithology	Age	GWB_Code	Code	Surf. km ²
1	Lezhe	Porous	Sedimentary	Sand, gravel, clay	Qh	Pacram-Velipoj	GWB001	217.1338
2	Shkoder	Porous	Sedimentary	Sand, gravel, clay	Qp-h	Dragoc-Grude-Fusha	GWB003	7.179744
3	Shkoder	Porous	Sedimentary	Sand, gravel, clay	Qp	Kopliku	GWB011	56.22148
4	Shkoder	Porous	Sedimentary	Sand, gravel, clay	Qp-h	Jubani	GWB014	6.165981
5	Shkoder	Porous	Sedimentary	Clay, alevrolite, sand	Qh	Luarzi-Reci	GWB005	5.474612
6	Diber	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Kacnija	GWB021	12.82191
7	Diber	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Fushe-Lura	GWB020	6.470905
8	Diber	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Fushe-Bulqize	GWB022	27.12081
9	Kukes	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Rragam	GWB031	34.02728
10	Kukes	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	GBradoshnice	GWB030	24.92025
11	Kukes	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Glmaj-Peraj	GWB032	15.35057
12	Kukes	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Gjegjet-Zall_Reç	GWB042	0.386786
13	Kukes	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Bajram-Curri	GWB028	35.96112
14	Lezhe	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Dragusha	GWB040	4.944199
15	Lezhe	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Hajmel_Rrabosht	GWB039	45.3024
16	Lezhe	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Lezhe_Manatie	GWB041	2.002294
17	Shkoder	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Qerreti_Madh	GWB038	2.189301
18	Shkoder	Porous	Sedimentary	Clay, alevrolite, sand	Qp	Bardhaj	GWB037	6.429407
19	Shkoder	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Theth-Boge-Zagore	GWB033	59.07687
20	Diber	Porous	Sedimentary	Clay, alevrolite, sand	Qh	Topojan	GWB044	0.535334
21	Shkoder	Porous	Sedimentary	Clay, alevrolite, sand	Qh	Velipoja	GWB043	25.08392

Table 24 - Aquifers in intergranular formations with low productivity.

No.	Index	District	Aquifer type	Rock type	Lithology	Age	GWB_Code	Code	Surf. km ²
1	Qp-h	Diber	Porous	Sedimentary	Clay, sand, gravel	Qp-h	Çaje-Radomire-Bellove	GWB018	27.18959
2	Qp-h	Diber	Porous	Sedimentary	Clay, sand, gravel	Qp-h	Ternove-Trebisht-Gjinovec	GWB023	4.978804
3	Qp-h	Korçe	Porous	Sedimentary	Clay, sand, gravel	Qp-h	Çervenak-Çerrave	GWB024	26.26628
4	Qp-h	Korçe	Porous	Sedimentary	Clay, sand, gravel	Qp-h	Lajthize-Rakicke	GWB025	7.118441
5	Qp-h	Kukes	Porous	Sedimentary	Clay, sand, gravel	Qp-h	Morine-Shishtavec	GWB019	49.08383
6	Qh	Shkoder	Porous	Sedimentary	Clay, sand, gravel	Qh	Ivanaj-Gashaj	GWB035	1.015527
7	Qh	Diber	Porous	Sedimentary	Clay, sand, gravel	Qh	Brezhdan-Lishan	GWB026	6.2483

8	Qh	Diber	Porous	Sedimentary	Clay, sand, gravel	Qh	Peshkopi-Shupenze	GWB016	61.91179
9	Qh	Diber	Porous	Sedimentary	Clay, sand, gravel	Qh	Sillove-Kishavec	GWB017	51.3344

Table 25 - Aquifers in intergranular formations with very low productivity.

No.	District	Aquifer type	Rock type	Lithology	Age	GWB-location	Code	Surface km ²
1	Kukes	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Lekbibaj-Zogaj	GWB027	12.02454
2	Kukes	Porous	Sedimentary	Clay, alevrolite, sand	Qp-h	Kernaje-Viçidol	GWB029	13.90541

Table 26 - Aquifers in compact formations with high productivity.

No.	District	Aquifer type	Rocks type	Lithology	Age	GWB-location	Code	Surf. km ²
1	Diber	Compact	Sedimentary	Limestone	T2-J2	Radomire-Kercisht	GWB072	22.668952
2	Diber	Compact	Sedimentary	Dolomite	T2-J2	Skavice-Lubeshe	GWB071	268.645881
3	Diber	Compact	Sedimentary	Limestone	T2-J2	Ostren-Zabzun	GWB073	97.441368
4	Korçe	Compact	Sedimentary	Limestone	T3-J1	Tushemisht-Tren	GWB074	233.908595
5	Kukes	Compact	Sedimentary	Dolomite	T3	Serme-Toplan	GWB064	15.530982
6	Kukes	Compact	Sedimentary	Dolomite	T3	Bradoshnice-Selimaj	GWB062	311.033926
7	Kukes	Compact	Sedimentary	Limestone	T3-J1	Bardhoc_Bushtrice	GWB068	92.195821
8	Kukes	Compact	Sedimentary	Limestone	T3-J1	Gabrica	GWB069	20.21056
9	Kukes	Compact	Sedimentary	Limestone	Cr1	Cahan-Mamez	GWB067	149.955973
10	Kukes	Compact	Sedimentary	Dolomite	T3	Bugjon-Miliska	GWB063	18.323532
11	Lezhe	Compact	Sedimentary	Limestone	Pg2	Torrovica	GWB077	30.812183
12	Lezhe	Compact	Sedimentary	Limestone	T3-J1	Kallmet-Manatia	GWB079	17.029557
13	Lezhe	Compact	Sedimentary	Limestone	Cr2	Arren-Merkurth	GWB070	102.742395
14	Lezhe	Compact	Sedimentary	Limestone	Pg2	Mali Rrencit-Shengjin	GWB078	64.132434
15	Shkoder	Compact	Sedimentary	Limestone	J1-2	Ura e Shtrenjt	GWB065	242.700512
16	Shkoder	Compact	Sedimentary	Limestone	T2	Shiroke-Zogaj	GWB075	17.14873
17	Shkoder	Compact	Sedimentary	Limestone	T2	Rragam-Mjede	GWB076	23.558111
18	Shkoder	Compact	Sedimentary	Limestone	T1-2	Koman - Kçira	GWB066	11.775563
19	Shkoder	Compact	Sedimentary	Limestone	T2	Vermoshi	GWB058	27.073483
20	Shkoder	Compact	Sedimentary	Limestone	Cr	Selca - Ivanaj	GWB060	471.143918
21	Shkoder	Compact	Sedimentary	Limestone	J3k	Theth - Drisht	GWB061	289.795334
22	Shkoder	Compact	Sedimentary	Dolomite	T3	Lepusha	GWB059	4.73715

Table 27 - Aquifers in compact formations with moderate productivity.

No.	District	Aquifer type	Rocks type	Lithology	Age	GWB location	Code	Surf. km ²
1	Diber	Compact	Magmatic&metamorphic	Basic	nPz	GWB_046_Cereni	GWB046	2.297829
2	Diber	Compact	Magmatic&metamorphic	Ultrabasic	gJ2-3	GWB_047_Poshte Radomires	GWB047	1.330589
4	Diber	Compact	Magmatic&metamorphic	Ultrabasic	sJ2	GWB_049_Fushe Bulqize Shytaj	GWB049	58.49437
7	Kukes	Compact	Magmatic&metamorphic	Ultrabasic	gJ2-3	GWB_045_Çeremi	GWB045	73.34018
9	Kukes	Compact	Magmatic&metamorphic	Basic	aJ2	GWB_052_Fushe Arrez	GWB052	639.5693

Table 28 - Aquifers in compact formations with low productivity.

No.	District	Aquifer type	Rocks type	Lithology	Age	GWB location	Code	Surf. km ²
1	Diber	Compact	Magmatic& metamorphic	Ultrabasic	sJ2	Fushe Lure	GWB048	83.03261
2	Diber	Compact	Magmatic& metamorphic	Ultrabasic	sdJ2	Bulqize-Kraste	GWB050	70.21203
3	Diber	Compact	Magmatic& metamorphic	Ultrabasic	sJ2	Gjinovec Klenj	GWB054	2.690385
4	Kukes	Compact	Magmatic& metamorphic	Ultrabasic	nJ2	Morine-Perrollaj	GWB051	516.551
5	Kukes	Compact	Magmatic& metamorphic	Acide	eP-T1	Bardhoc-Bushtrica	GWB057	9.567539
6	Lezhe	Compact	Magmatic& metamorphic	Ultrabasic	sJ2	Dushi	GWB053	183.4716
7	Korcë	Compact	Magmatic& metamorphic	Ultrabasic	sJ2	Memelisht-Peshkepi	GWB055	35.41904
8	Korcë	Compact	Magmatic& metamorphic	Ultrabasic	sJ2	Buzliqeni - Treni	GWB056	2.966939
9	Diber	Compact	Magmatic& metamorphic	Vulcanite	T1-2	Radomire-Trepca	GWB099	53.03799
10	Diber	Compact	Sedimentary	Clay, sandstone, conglomerate	Pg2-Pg3	Vlesha-Vrenjti	GWB095	13.78456
11	Diber	Compact	Sedimentary	Clay, sandstone, conglomerate	N2-Qp	Arras-Fushe Muhur	GWB097	6.668032
12	Diber	Compact	Sedimentary	Clay, sandstone, conglomerate	N2-Qp	Shumbat-Brest i Poshtem	GWB096	14.44019
13	Diber	Compact	Magmatic& metamorphic	Vulcanite	T1-2	Ushtenica	GWB098	25.86977
14	Diber	Compact	Magmatic& metamorphic	Vulcanite	T1-2	Qaf_Murre_Kacni	GWB101	2.49181
15	Diber	Compact	Sedimentary	Clay, sandstone, conglomerate	N2	Valikardhe-Çerenec	GWB102	7.196516
16	Diber	Compact	Magmatic& metamorphic	Vulcanite	T1-2	Shqath-Bllaca	GWB100	9.78957
17	Korçe	Compact	Magmatic& metamorphic	Vulcanite	bT2-J1	Kostricani	GWB103	3.597513
18	Korçe	Compact	Sedimentary	Clay, conglomerate	Pg3-N1a	Çervenaka-Remenji	GWB104	23.08707
19	Korçe	Compact	Sedimentary	Clay, sandstone, conglomerate	N2	Pogradec - Grabovice	GWB105	45.12679
20	Korçe	Compact	Sedimentary	Clay, sandstone, conglomerate	N2	Gorica e Madhe	GWB106	6.435211
21	Korçe	Compact	Sedimentary	Clay, sandstone, conglomerate	N2	Liqenas_Cerja	GWB107	6.51584
22	Kukes	Compact	Magmatic& metamorphic	Vulcanite	IJ2	Berishe-Krume	GWB084	55.01351
23	Kukes	Compact	Magmatic& metamorphic	Vulcanite	IJ2	Çibuk-Shikaj	GWB085	12.68839
24	Kukes	Compact	Magmatic& metamorphic	Vulcanite	bT2-J1	Morine-Aliaj	GWB091	43.42486
25	Kukes	Compact	Magmatic& metamorphic	Vulcanite	IJ2	Lumbardhi	GWB090	7.464132
26	Kukes	Compact	Magmatic& metamorphic	Vulcanite	bT2-J1	Gegaj-Babina	GWB081	19.88867
27	Kukes	Compact	Sedimentary	Clay, sandstone, conglomerate	N2	Porav_Gojan	GWB083	34.18449
28	Kukes	Compact	Sedimentary	Clay, sandstone, conglomerate	N2	Luzha	GWB082	7.156
29	Lezhe	Compact	Magmatic& metamorphic	Vulcanite	bT2-J1	Mnelle e Vogel - Ranza	GWB092	25.499
30	Shkoder	Compact	Magmatic& metamorphic	Vulcanite	T1-2	Buzhale-Kcira	GWB088	23.5621

31	Shkoder	Compact	Sedimentary	Limestone	T2	Vermosh	GWB080	6.160638
32	Shkoder	Compact	Sedimentary	Clay, sandstone, conglomerate	N2-Qp	Koplik-Dobraç	GWB087	2.642764
33	Shkoder	Compact	Sedimentary	Clay, sandstone, conglomerate	N2-Qp	Qaf Grad-Gruemire	GWB086	8.477286
34	Shkoder	Compact	Magmatic& metamorphic	Vulcanite	bJ2	Kabashe-Lajthiza	GWB089	29.08027
35	Diber	Compact	Magmatic& metamorphic	Vulcanite	bT2-J1	Çaja	GWB094	7.574482
36	Diber	Compact	Magmatic& metamorphic	Vulcanite	bT2-J1	Pregj Lure - Bushtrica	GWB093	14.185

Table 29 Aquifers in compact formations with very low productivity.

No.	District	Aquifer type	Rocks type	Lithology	Age	GWB location	GWB Code	Surf. km ²
1	Korçe	Compact	Sedimentary	Clay, sandstone, conglomerate and terrigenous material	J3t-Cr2m	Cerenec-Stebleva	GWB115	201.1604
2	Korçe	Compact	Sedimentary	Flysch	Pg3-3	Çervenak-Stopcka	GWB116	28.19892
3	Kukes	Compact	Sedimentary	Flysch	Cr2m-Pg2	Breg Lumi - Buzhala	GWB109	113.1547
4	Kukes	Compact	Magmatic& metamorphic	Conglomerates and metamorphized sandstones	P	Peraj-Lekbibaj	GWB108	101.6929
5	Lezhe	Compact	Sedimentary	Flysch	Pg1-2	Manati-Hajmel	GWB113	44.819
6	Lezhe	Compact	Sedimentary	Flysch	Pg1-2	Melgushe-Dajç-Milot	GWB114	19.90488
7	Shkoder	Compact	Sedimentary	Flysch	Pg1-2	Vidhgari-Berdice e Madhe-Suka e Djegur	GWB111	37.37224
8	Shkoder	Compact	Sedimentary	Sandstone, marls, conglomerate, clays and miscellaneous terrigenous material	J3	Barcolle-Gomsiqe e Eperme	GWB110	38.37821
9	Shkoder	Compact	Sedimentary	Sandstone, marls, conglomerate, clays and miscellaneous terrigenous material	J3	Kaptall_Vigu	GWB112	10.1463

Notes to the inventory:

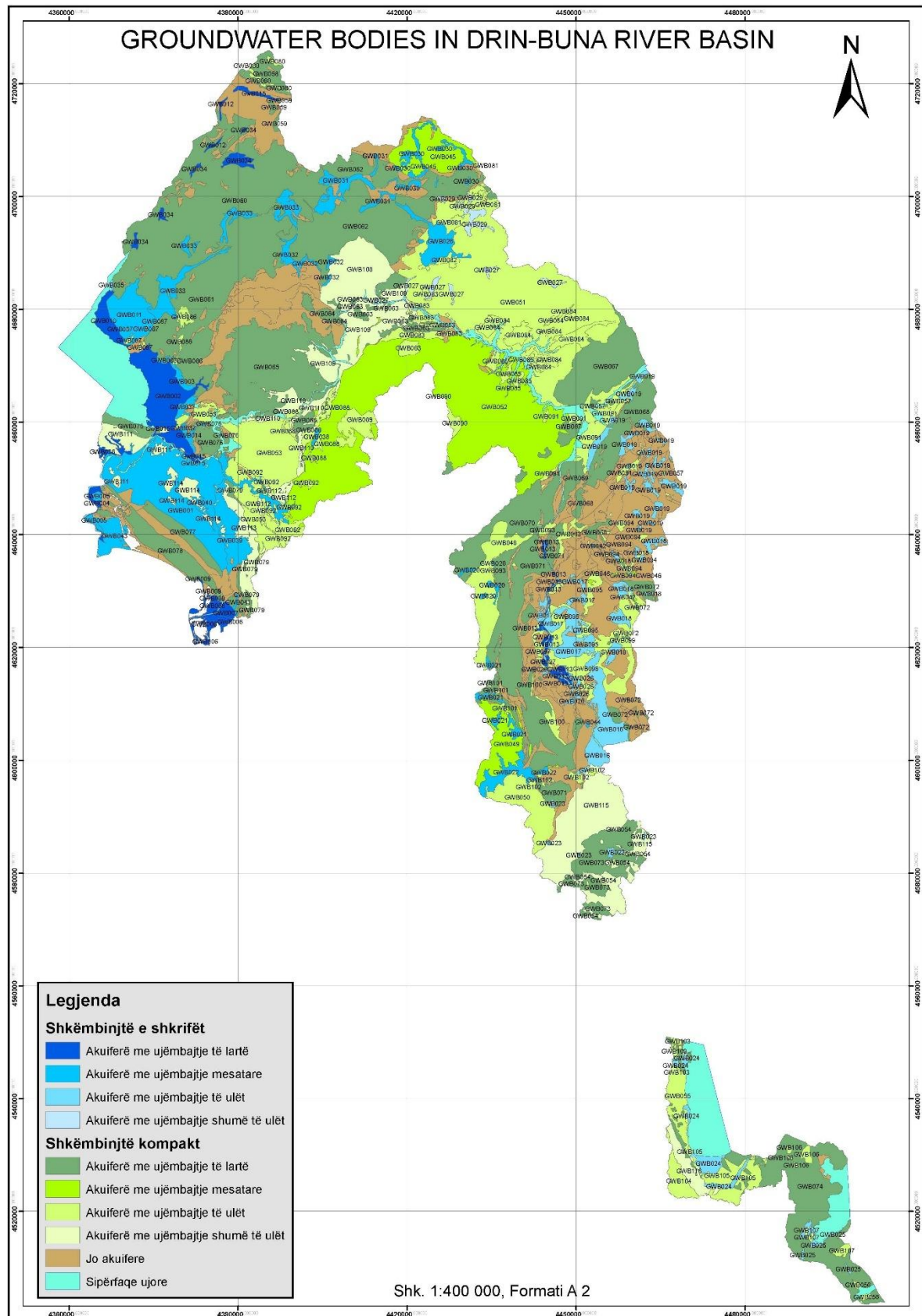
1. Parent geology is derived from the Albanian Geological Survey.
2. Waterbody code and type code are derived from the Hydrogeologist Expert.
3. Horizon determines level of groundwater within the parent aquifer.
4. Aquifer type follows EU WISE standard types.
5. Hb - Depth is hydraulic property average saturated depth of aquifer.
6. Sv - is hydraulic property - Specific yield.
7. Hk - is hydraulic property - Hydraulic conductivity, K - Coefficient of permeability.
8. Ht - is hydraulic property - Transmissivity, K x b.
9. *Transboundary* indicates that the groundwater waterbody extends beyond the surface topographical divide of an adjacent river basin.
10. *Dependent ecosystem* (GWDTE) definition complies with WISE 2016 reporting schema:
 - a) Dependent ecosystem (GWDTE) - "Groundwater-dependent terrestrial ecosystems (GWDTE) are terrestrial ecosystems that rely partially or fully on the groundwater body (GWB) to sustain their ecological functions, habitat structure, and biological communities. They depend on groundwater level, pressure, discharge, or subsurface moisture conditions. According to the WISE 2016 reporting schema, the relationship between a groundwater body and its dependent ecosystems is reported through the 'Link Terrestrial/Ecosystem(s)' schema element, which identifies the presence of dependent ecosystems, describes their type, and assesses potential risks arising from changes in groundwater conditions."

- b) Link Terrestrial/Ecosystem(s) (WISE 2016 schema element) - "A reporting element within the WISE 2016 Groundwater Body (GWB) schema used to indicate whether a groundwater body supports groundwater-dependent terrestrial ecosystems (GWDTE).

The element records:

- (i) the existence of linked ecosystems (Yes/No);
- (ii) the identification or description of the ecosystem, and;
- (iii) the risk assessment related to groundwater pressures and impacts. This element forms part of the characterization and risk assessment of each GWB.

CONCEPT



Map 4 - Drin-Buna River Basin: Groundwater Body Category and Delineation.

7.6 Characterisation and Delineation of Protected Areas

7.6.1 European Union Context

Under Article 6 and Annex IV of the WFD, each River Basin must establish a Register of Protected Areas. This register includes all areas that require special protection for surface water, groundwater, or habitats and species directly dependent on aquatic ecosystems. Competent authorities must also prepare maps showing the location and extent of each protected area and describe the national or EU legislation under which each area has been designated.

Protected areas form an integral part of river basin management planning. They link WFD objectives with the objectives of other water-related and biodiversity legislation. Where protected area objectives are more specific or more stringent than the general WFD objective of good status, the RBMP must take these requirements into account.

7.6.2 Protected Areas in the Drin-Buna River Basin

Protected areas in the Drin-Buna River Basin are regulated under Law No. 29/2024 on Water Resources and are aligned with WFD Article 6 and Annex IV. They include areas for drinking water supply, fisheries, recreation, nutrient protection, and nature conservation. Their designation and management support the alignment of Albanian river basin planning with EU water and biodiversity policy. The protected area register includes five main categories.

Drinking Water Protected Areas

Under Article 7 of the WFD, all water bodies used for the abstraction of more than 10 m³/day, or serving more than 50 persons, must be identified as Drinking Water Protected Areas (DWPAs). For groundwater, the DWPA must cover the entire delineated groundwater body, rather than only the immediate abstraction point. Where a contiguous aquifer provides drinking water and is not subdivided into smaller groundwater bodies, the full aquifer must therefore be designated as a DWPA.

DWPAs must be distinguished from safeguard or protection zones under WFD Article 7(3). These zones define where restrictions are needed to protect the drinking water source. International practice commonly applies three concentric protection zones: an outer source catchment zone, an intermediate buffer zone and an inner security zone. The outer zone corresponds to the DWPA itself and supports general land-use and pollution-control measures. The intermediate zone controls risk from priority hazardous substances and river basin specific pollutants. The inner zone protects the immediate well-head or abstraction point against direct contamination.

The Drin-Buna basin is a critical source of drinking water for Shkodër, Kukës, and Lezhë, with most water derived from groundwater springs and wells. According to data from the local water utility, some sources have designated protection perimeters (measured in meters) around the abstraction points. However, in practice, the infrastructure and enforcement to secure these zones is often missing or inadequate. Information on these protection areas is not yet included in a consolidated register, and systematic mapping is lacking. As a result, while some protection measures exist on paper, their effectiveness in safeguarding water sources remains uncertain. Private wells, widely used in rural areas, remain outside the formal system.

Drinking water zones are intended to secure clean water for human consumption and directly support the WFD objective of good chemical status. Without reliable mapping, monitoring and effective protection infrastructure, drinking water sources remain vulnerable to pollution.

Areas for the Protection of Economically Significant Aquatic Species

Areas for the protection of economically significant aquatic species are designated under Article 6 and Annex IV of the WFD. These areas protect surface waters that support species of economic value, such as fish, shellfish, or crustaceans. They require water quality that supports the health, reproduction, and sustainable exploitation of the species concerned.

The Drin-Buna basin contains some of Albania's most ecologically and economically valuable fisheries resources. Three jointly managed fisheries zones are designated⁸⁴:

- Lake Shkodra and Buna River (DCM 469/2016) – the largest lake in the Balkans, a Ramsar site, and a critical wetland for fish spawning and migratory birds. Traditional fishing is allowed under strict rules.
- Ohrid Lake (DCM 283/2016) – a UNESCO site with high endemism and long-standing fisheries.
- Prespa Lakes (DCM 734/2017) – important for transboundary fisheries and biodiversity.

These zones operate through local fisheries organisations, under management plans that regulate fishing methods, vessel use, and catch limits, with the aim of sustainable exploitation and ecosystem balance, thus contributing to the WFD's ecological objectives.

Recreational and Bathing Waters

Bathing waters are designated under Article 6 and Annex IV of the WFD and in line with the Bathing Water Directive. They include surface waters regularly used for bathing and therefore require protection to safeguard human health and maintain suitable recreational water quality.

Bathing waters in the Drin-Buna River Basin are designated annually by Decision of the Council of Ministers, including Shëngjin, Rana e Hedhun, Baks Rrjollë and Velipojë. However, monitoring remains limited and Albania does not yet operate a comprehensive programme fully aligned with the EU Bathing Water Directive. Coastal water-quality impacts from urban discharges have not been systematically assessed for the Drin-Buna coast.

The 2023 State of the Environment Report shows mixed results. In Velipojë, bathing water quality remained mostly good, with one excellent and one sufficient station, but the decline in excellent-quality sites indicates a gradual deterioration. In Shëngjin, conditions worsened significantly: no station reached excellent quality in 2023, and most stations were classified as poor or sufficient, marking a clear decline compared with 2022.

Overall, the limited number of monitoring sites, weak public reporting and declining quality at key tourist beaches indicate that the protection of bathing waters and public health is not yet fully secured. Further alignment with the WFD and the EU Bathing Water Directive is needed, particularly in coastal areas where recreation and tourism are important water uses.

Nutrient-Sensitive Zones

EU legislation requires the designation of areas that need protection against nutrient pollution from diffuse and point sources. Under the Nitrates Directive, Nitrate Vulnerable Zones (NVZ) must be designated where agricultural practices may cause nitrate concentrations to exceed 50 mg/l in waters used, or potentially used, for drinking water abstraction. Under the Urban Wastewater Treatment Directive, Nutrient-Sensitive Areas (NSA) must be designated where waters are eutrophic, at risk of becoming eutrophic, or require additional wastewater treatment to protect aquatic habitats and species.

No Nitrate Vulnerable Zones or Nutrient Sensitive Areas have yet been designated in the Drin-Buna basin, even though the Water Resources Law provides for them. Monitoring data from 2023⁸⁵ show nitrate levels fall within Class I-High Status. This means that, for now, the waters at the monitoring sites, are not affected by nutrient pollution, and the environmental objective of avoiding eutrophication is being met in practice.

Nature Protection Areas for Habitats and Species

Nature protection areas are designated under Article 6 and Annex IV of the WFD for the protection of habitats and species directly dependent on water. They include areas linked to the Birds Directive and the Habitats Directive and, in the EU context, form part of the Natura 2000 network. These areas require water status and management measures that maintain or restore the ecological conditions needed to achieve conservation objectives.

⁸⁴ <https://www.fao.org/faolex/results/details/en/c/LEX-FAOC163407>

⁸⁵ NEA, Environmental Report, 2023.

The Drin-Buna River Basin contains a wide network of nationally and internationally protected areas. These include: national parks (e.g., Alpet e Shqipërisë, Lurë–Mali i Dejës, Shebenik), nature reserves (Liqeni i Shkodrës, Kune-Vain), protected landscapes (Buna-Velipojë, Liqeni i Pogradecit), as well as Ramsar wetlands, Emerald sites, Important Bird Areas, and UNESCO World Heritage sites. These sites safeguard wetlands, rivers, lakes, forests, and mountain ecosystems, many of which are directly water-dependent.

These areas protect wetlands, rivers, lakes, forests, and mountain ecosystems, many of which are directly water dependent. They contribute to biodiversity conservation and support the WFD objective of good ecological status. However, several protected areas still lack approved management plans. In addition, protected area management plans are not yet fully integrated into territorial development planning and river basin management planning. This leads to fragmented planning and reduces the effectiveness of conservation measures. Weak enforcement further limits the capacity of protected areas to address pressures effectively.

7.6.3 Register of Protected Areas

The Register of Protected Areas provides the formal overview of all protected areas in the Drin-Buna River Basin that are relevant for WFD implementation. It identifies the protected area category, location, legal basis and relationship with surface water bodies and groundwater bodies. The register also supports the preparation of maps and the integration of protected area objectives into monitoring, status assessment, and the Programme of Measures.

For the Drin-Buna River Basin, the register includes drinking water protected areas, areas for economically significant aquatic species, bathing waters, nutrient-sensitive zones where designated, and nature protection areas for habitats and species. The register must be maintained and updated as new information becomes available, including improved mapping of drinking water protection zones, updated bathing water classifications, future designation of nutrient-sensitive areas and further clarification of water-dependent nature protection objectives.

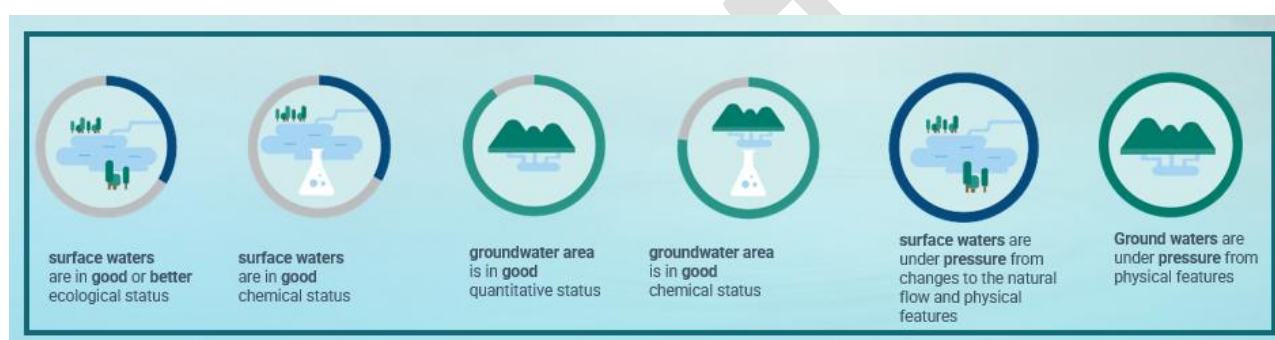
Task Report 2 contains the full Register of Protected Areas, also summarized in Chapter 13.



8 ENVIRONMENTAL OBJECTIVES FOR THE RIVER BASIN

This chapter summarises the environmental objectives applied in this River Basin Management Plan. It translates the technical framework developed in the Task Report 5, Environmental Objectives for Surface, and Groundwater, into a policy-oriented description. The detailed definitions, assessment methods, proposed standards, quality elements, threshold values, and methodological references are presented in the Task Report 5.

The chapter explains what the objectives mean for surface water bodies, groundwater bodies, and water-related protected areas. It also clarifies how Albania will progressively strengthen the technical basis for WFD-compliant status assessment, including reference conditions, monitoring programmes, environmental quality standards, and class boundaries.



8.1 Purpose of environmental objectives in the RBMP

Environmental objectives define what the RBMP aims to achieve for each water body and for each water-dependent protected area. They provide the link between water body characterisation, pressure analysis, monitoring, status assessment, and the Programme of Measures. They therefore guide public investment, permitting, inspection, restoration planning, and institutional cooperation.

This RBMP applies the objective framework of the EU WFD and the Albanian Water Resources Law No. 29/2024. The objectives focus on preventing deterioration, improving water status where needed, and securing the water conditions required for protected areas and legitimate water uses. The RBMP treats water quality, water quantity, hydro morphology, and ecosystem functioning as connected parts of one river basin management system.

For surface waters, the RBMP aims to achieve good surface water status. This requires both good ecological status, or good ecological potential for heavily modified and artificial water bodies, and good chemical status. For groundwater, the RBMP aims to achieve good groundwater status. This requires both good quantitative status and good chemical status. For protected areas, the RBMP also applies the standards and objectives of the legislation under which the areas have been designated. Where these objectives are more stringent than the general WFD objective of good status, the more stringent objective applies.

Table 30 Purpose of environmental objectives in the RBMP.

Water category	Main environmental objective	What this means for RBMP implementation
Surface water bodies	Prevent deterioration and achieve good ecological status/potential and good chemical status.	Set type-specific objectives, assess biological, physico-chemical, and hydro morphological quality elements, control priority substances and implement measures where status is below objective.

Groundwater bodies	Prevent or limit pollutant inputs, prevent deterioration and achieve good quantitative and chemical status.	Balance abstraction with long-term recharge, protect connected surface waters and dependent ecosystems, apply groundwater quality standards and reverse significant upward pollution trends.
Protected areas	Meet the standards and objectives of the relevant protected area legislation in addition to WFD objectives.	Maintain a protected area register, align monitoring and measures with drinking water, bathing water, nutrient-sensitive, habitat, and species protection requirements.

8.2 Policy and legal basis

Albania is aligning its water management system with the EU environmental acquis under Chapter 27. The WFD provides the core framework for integrated river basin management. Law No. 29/2024 on Water Resources establishes the national basis for setting environmental objectives for surface water bodies, groundwater bodies, and water-related protected areas through river basin management planning. It requires WRMA / AMBU and the responsible authorities to protect, improve and restore water bodies and to implement Programmes of Measures that support good status, good ecological potential, and protected area compliance.

The RBMP uses the WFD Article 4 objective structure. This means that competent authorities must prevent deterioration in the status of all water bodies, protect and enhance aquatic ecosystems, progressively reduce pollution, protect groundwater resources, and ensure that measures deliver the required status improvements. The RBMP also recognises that Albania is still building the technical and institutional system needed to demonstrate full compliance. Current limitations in monitoring coverage, data availability, laboratory capacity, biological assessment, and classification methods reduce the confidence of some status assessments. The RBMP therefore combines immediate environmental objectives with a stepwise programme to strengthen the evidence base.

The Task Report 5 explains how the assessment system should develop. It highlights the need to establish national ecological reference conditions, expand WFD-compliant monitoring, define type-specific class boundaries, apply EU standards for priority substances, identify river basin specific pollutants, and improve groundwater quantity and quality assessment. The RBMP uses these technical steps as part of its implementation process.

8.3 Environmental objectives for surface water bodies

8.3.1 Overall objective

The RBMP sets the following overall objective for surface water bodies: prevent deterioration and achieve good surface water status. Good surface water status requires good ecological status and good chemical status. Where a water body has been properly designated as heavily modified or artificial, the ecological objective becomes good ecological potential, while the requirement for good chemical status remains unchanged.

Ecological status describes the quality of the structure and functioning of aquatic ecosystems. It reflects how biological communities respond to pressures such as urban wastewater, agricultural nutrient losses, hydropower, abstraction, flow regulation, river continuity barriers, channel modification, and habitat degradation. The RBMP therefore uses ecological status not only as a monitoring result, but also as a management signal: where biology, water quality, flow, or morphology show deterioration, measures must address the underlying pressure.

8.3.2 Ecological status and ecological potential

The WFD classifies ecological status into five classes: high, good, moderate, poor, and bad. The classification compares observed conditions with type-specific reference conditions. Reference conditions represent high ecological status and describe conditions with no, or only very minor, human

alteration. Good status allows only slight deviation from these conditions. Moderate, poor, and bad status indicate increasing ecological alteration.

Table 31 - Surface water status assessment.

High Status		No, or only very minor, anthropogenic alteration of biological, physico-chemical, and hydro morphological quality elements.
Good Status		Slight deviation from reference conditions in the composition and abundance of biological quality elements; supporting physico-chemical and hydro morphological conditions are consistent with good ecological functioning.
Moderate Status		Moderate deviation from reference conditions; supporting physico-chemical and hydro morphological conditions are consistent with moderate ecological functioning.
Poor Status		Major alteration of biological quality elements.
Bad Status		Severe alteration of biological quality elements.

For natural surface water bodies, the RBMP aims for good ecological status. For heavily modified water bodies (HMWBs) and artificial water bodies (AWBs), the RBMP aims for good ecological potential. This objective recognises that some physical modifications support specified uses such as hydropower, flood protection, navigation, water supply, or irrigation & drainage. However, HMWB or AWB designation does not legitimise avoidable impacts. It requires a transparent water body-specific test and must be accompanied by all mitigation measures that can be implemented without significant adverse effects on the specified use.

8.3.3 Biological quality elements and reference conditions

The RBMP assesses ecological status through biological quality elements supported by physico-chemical and hydro morphological quality elements. The relevant biological quality elements include Fish, Benthic Invertebrates (macrofauna), Phytobenthos and Macrophytes:

- Fish communities indicate the ecological condition of rivers and lakes. Their species composition, abundance and age structure reflect pressures such as barriers, altered flow, habitat degradation, and pollution.
- Invertebrates (macrofauna) are small animals living on or near the river or lakebed. They respond quickly to organic pollution, oxygen stress, habitat quality, and hydro morphological changes.
- Phytobenthos are algae and microorganisms attached to stones, sediment, or plants. They are mainly used to assess nutrient enrichment, light conditions, and general water quality. Benthic diatoms form a specific and widely used component of the phytobenthos, because they provide sensitive indicators for nutrient enrichment and pollution.
- Macrophytes are larger aquatic plants, including submerged, floating, and emergent species. Their presence, abundance and composition reflect nutrient levels, water depth, flow conditions, and habitat structure.

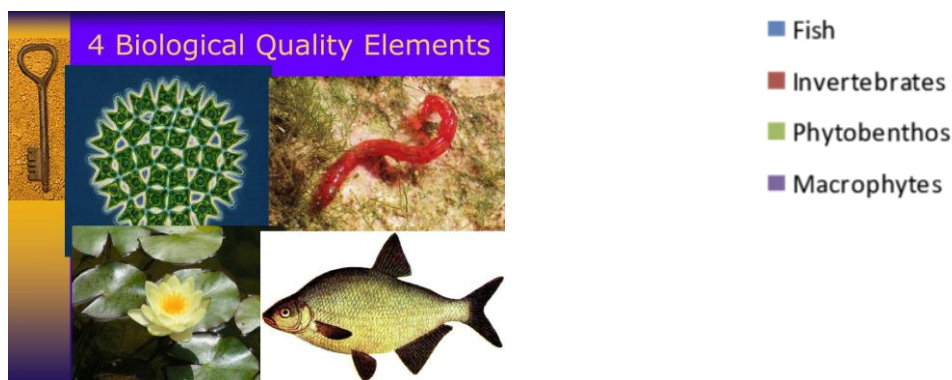


Figure 22 - Biological quality elements.

The RBMP recognizes biological quality elements as the core evidence for ecological status. Biological communities integrate the effects of multiple pressures over time and therefore provide a stronger indication of ecosystem health than individual chemical measurements alone. The Task 5 Report identifies benthic diatoms, benthic macroinvertebrates, and other biological groups as key elements for developing Albania's ecological assessment system.

For benthic diatoms, the assessment can use indices that respond to nutrient enrichment, organic pollution, and general pollution sensitivity, including the Trophic Diatom Index, Saprobic Index, Specific Pollution Sensitivity Index, and community diversity metrics. For benthic macroinvertebrates, the assessment can use multimetric approaches consistent with the AQEM concept, including EPT taxa, BMWP, ASPT, Shannon-Wiener diversity, Margalef diversity and saprobic indices.

These metrics should not be interpreted in isolation. Albania should normalise and combine them into type-specific multimetric assessment methods and express results as Ecological Quality Ratios (EQRs).

At this stage, Albania has not yet established a complete set of national biological reference conditions and class boundaries for all surface water types. The RBMP therefore treats current ecological classifications as provisional where the data basis remains limited. During this planning cycle, the competent authorities should use the expanding biological monitoring data from the basins to identify low-pressure reference sites, develop pressure-response relationships, establish preliminary class boundaries, and prepare future intercalibration or alignment with comparable European methods.

8.3.4 General physico-chemical conditions

General physico-chemical conditions support biological status and help explain the pressures affecting aquatic ecosystems. The analysis uses parameters such as dissolved oxygen, BOD5, nutrients, pH, conductivity, temperature, suspended solids, salinity, and transparency to identify pressure patterns and to support ecological classification.

Nutrient enrichment, organic pollution, and oxygen depletion are particularly relevant pressures in Albanian river basins, especially where untreated or insufficiently treated wastewater and agricultural run-off affect rivers and lakes.

The analysis applies a stepwise approach. In the short term, existing NEA classification schemes and available monitoring data provide an interim basis for assessment. In parallel, Albania should develop WFD-compliant type-specific ranges for general physico-chemical elements. These ranges must be stringent enough to support good biological status and must reflect natural differences between water body types, altitude, geology, climate, and hydrological regime.

8.3.5 Chemical status

EU water legislation addresses chemical pollution in surface waters through two complementary components:

- EU-wide substances: *priority substances* (including *priority hazardous substances*) are identified and regulated at EU level under the WFD, with Environmental Quality Standards (EQS) set in the EQS Directive 2008/105/EC, as amended by Directive 2013/39/EU⁸⁶.
- River basin specific pollutants (RBSPs): additional pollutants of national or local concern are identified by Member States (or competent authorities) and controlled at the appropriate river basin level.

Surface water bodies are classified into 5 water quality categories of regulatory compliance:

1. **High Status:** No or very minor anthropogenic impacts; meets natural background levels.
2. **Good Status:** Meets all European Environmental Quality Standards (EQS).
3. **Moderate Status:** Certain chemical concentrations exceed baseline levels but have not triggered widespread ecological collapse.
4. **Poor Status:** Chemical pollutants (such as nitrates or pesticides) are consistently failing safety thresholds.
5. **Bad Status:** Severe chemical degradation that results in the loss of biological communities.

Good chemical status for surface water requires compliance with the Environmental Quality Standards for all EU priority substances and certain other pollutants. The RBMP recognises that routine monitoring for the full priority substance list is not yet in place. This creates uncertainty in chemical status classification. The Programme of Measures therefore needs to prioritise the establishment of a WFD-compliant chemical monitoring programme, including priority substances, relevant matrices such as water, sediment or biota, and quality-assured laboratory procedures.

The RBMP also recognises the need to identify river basin specific pollutants. These are pollutants of national, regional, or local concern that are discharged in significant quantities and that may affect ecological status. Albania should use pressure analysis, emission inventories, monitoring results, industrial and mining information, agricultural pesticide use, wastewater data, and expert judgement to compile the first basin-specific pollutant lists.

8.3.6 Environmental flow, hydro morphology, and hydropower

Flow regime and hydro morphology strongly influence ecological status. Rivers require not only a minimum flow during dry periods, but a seasonal flow regime that supports habitat diversity, sediment transport, migration, reproduction, oxygen dynamics, and ecosystem resilience. The RBMP therefore treats environmental flow as a regime, not only as a single fixed low-flow threshold.

Current Albanian practice often relies on a single minimum-flow value such as Q97 or Q355. This approach provides a simple interim safeguard but does not fully protect ecological functioning across seasons and hydrological conditions. The RBMP therefore sets a medium-term objective to move towards environmental flow requirements based on flow-duration curves and ecological flow-response relationships. This transition requires reliable hydrometric data, naturalised flow series, improved abstraction and return-flow records, and stronger monitoring of ecological responses.

Hydro morphological pressures are especially relevant where hydropower plants, dams, weirs, diversions, and depleted reaches alter flow continuity, and habitat conditions. The RBMP requires a transparent assessment of these pressures. Where hydropower or other physical modifications substantially change the character of a water body, the competent authorities may consider HMWB designation only after applying the full WFD Article 4(3) test. They must demonstrate that restoration to good ecological status would significantly affect the specified use and that no technically feasible, significantly better environmental alternative exists at proportionate cost. Even where designation is justified, the RBMP must define good ecological potential and require feasible mitigation measures, including environmental flow regimes, fish migration measures, continuity restoration, and operational improvements where relevant.

⁸⁶ European Commission – Water Framework Directive, Article 16, and Annex X replaced by EQSD, Annex II.

8.3.7 Overall surface water status assessment

The RBMP determines overall surface water status through the one-out-all-out principle. A water body achieves good surface water status only when ecological status or potential and chemical status are both good. Within ecological status, the lowest classed relevant quality element determines the outcome. This principle prevents strong performance in one element from masking failure in another. It also helps decision-makers identify the pressure that constrains objective achievement.

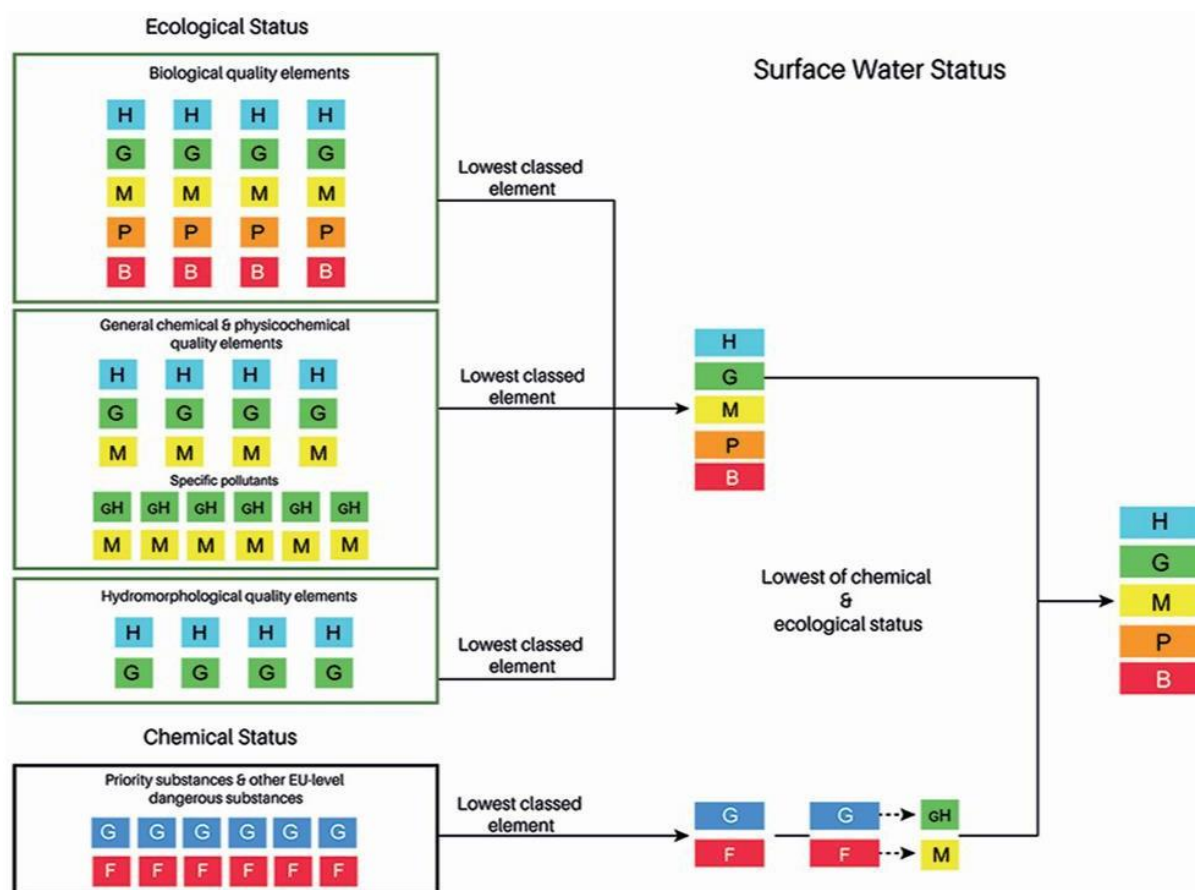


Figure 23 - Procedure for Overall Status Assessment of Surface Waterbodies.

8.4 Environmental objectives for groundwater bodies

8.4.1 Overall objective

The RBMP sets the following objective for groundwater bodies: prevent deterioration and achieve good groundwater status. Good groundwater status requires both good quantitative status and good chemical status. The RBMP also protects groundwater functions, including drinking water supply, baseflow to rivers, support for groundwater-dependent terrestrial ecosystems and long-term availability for legitimate water uses.

8.4.2 Quantitative status

Good quantitative status requires a sustainable long-term balance between groundwater recharge and abstraction. The available groundwater resource must not be exceeded by long-term annual average abstraction. Groundwater abstraction must also not prevent associated surface waters from achieving their ecological objectives and must not damage groundwater-dependent terrestrial ecosystems.

The RBMP recognises that groundwater and surface water form one connected resource. Excessive groundwater abstraction can lower groundwater levels, reduce spring discharge, reduce river baseflow,

alter the hyporheic zone and increase ecological stress during low-flow periods. Spring capture for water supply may have limited impact on the groundwater body at the point of discharge, but it can reduce baseflow in the receiving surface water body and therefore affect surface water ecological status.

Current groundwater-level monitoring and hydrometric data are not yet sufficient to quantify recharge, abstraction pressure, and groundwater-surface water interactions with high confidence in all groundwater bodies. The RBMP therefore treats the current groundwater quantitative assessment as indicative where data are limited. It sets a clear implementation priority to strengthen groundwater-level monitoring, abstraction registration, spring-flow monitoring, water-balance assessment and, where necessary, groundwater modelling.

8.4.3 Chemical status and trend reversal

Good groundwater chemical status requires pollutant concentrations to remain below groundwater quality standards and threshold values. It also requires that pollution does not cause saline or other intrusion, does not compromise associated surface water objectives, does not damage groundwater-dependent terrestrial ecosystems, and does not increase treatment needs for drinking water production.

The RBMP applies the Groundwater Directive logic. Nitrate and pesticides have EU groundwater quality standards. For other pollutants and indicators, competent authorities must establish threshold values that reflect natural background levels, groundwater uses, interactions with surface waters and groundwater-dependent ecosystems, and the hydrogeological characteristics of each groundwater body. Relevant parameters include arsenic, cadmium, lead, mercury, ammonium, chloride, sulphate, conductivity, trichloroethylene, and tetrachloroethylene, among others.

The RBMP also requires the identification and reversal of significant and sustained upward trends in pollutant concentrations in groundwater bodies at risk. Trend assessment requires long-term monitoring datasets. Because such datasets are currently limited in Albania, this RBMP prioritises the development of groundwater quality monitoring time series and the definition of starting points for trend reversal, normally based on a percentage of the relevant quality standard or threshold value.

8.4.4 Groundwater-dependent ecosystems

Groundwater-dependent terrestrial ecosystems and associated surface waters require specific attention because they may fail their ecological objectives when groundwater quantity or quality deteriorates. The RBMP uses groundwater body characterisation and risk assessment to identify ecosystems that may depend on groundwater discharge. Where the Baseflow Index indicates a high groundwater contribution to river flow, or where wetlands, springs or protected habitats depend directly on groundwater, the Programme of Measures should protect both groundwater levels and groundwater quality.

Specialist ecological and hydrogeological surveys may be required to confirm groundwater dependency and define the conditions needed to protect these ecosystems. The RBMP therefore links groundwater objectives to protected area management, environmental flow assessment, abstraction control, and land-use measures in recharge zones.

8.4.5 Overall groundwater status assessment

For groundwater, overall status is determined by the poorer of quantitative status and chemical status and is therefore classified as either:

Table 32 - Groundwater status assessment.

Good		A sustainable long-term balance between groundwater recharge and abstraction and pollutant concentrations to remain below groundwater quality standards and threshold values.
Fail		A long-term unbalance between groundwater recharge and abstraction and pollutant concentrations to are above groundwater quality standards and threshold values.

8.5 Environmental objectives for protected areas

The WFD requires each river basin to maintain a register of protected areas. Protected areas include water bodies used for drinking water abstraction, areas designated for economically significant aquatic species, bathing and recreational waters, nutrient-sensitive areas and areas designated for the protection of habitats and species where water status forms an important protection factor.

Protected areas are subject to the general WFD objectives and to the specific objectives of the legislation under which they were designated. Where a protected area coincides with a surface water body or groundwater body, both objective frameworks apply. In practice, this means that good status may not be sufficient where the protected area requires more stringent water quality, quantity, habitat, or health-related conditions.

8.5.1 Drinking water protected areas

For waters used for drinking water abstraction, the RBMP aims to protect raw water quality and to avoid deterioration. The objective is to ensure that drinking water can be produced under the treatment regime applied and that authorities reduce, where possible, the level of purification treatment needed. Measures may include protection zones, abstraction control, pollution prevention, monitoring of raw water quality, land-use restrictions, and stronger enforcement against contamination risks.

8.5.2 Bathing and recreational waters

For bathing and recreational waters, the RBMP supports the objectives of the Bathing Water Directive: protect human health, prevent and reduce pollution, classify bathing water quality, and inform the public. Albania already monitors some recreational waters, but the RBMP recognises that identification, characterisation, profiling, and classification need further alignment with EU requirements. Measures should address pollution sources that may affect bathing waters, including wastewater discharges, stormwater overflows, diffuse pollution, and poor sanitation infrastructure.

8.5.3 Nutrient-sensitive areas and nitrate vulnerable zones

Nutrient enrichment remains a key pressure for many surface waters. The RBMP therefore links WFD ecological objectives with the Nitrates Directive and the Urban Wastewater Treatment Directive. The objective is to reduce and prevent water pollution caused by nitrates from agricultural sources and to control nutrient discharges from agglomerations and wastewater treatment plants. Where water bodies show eutrophication risk, the Programme of Measures should include agricultural nutrient management, improved wastewater treatment, sensitive area designation where appropriate, and targeted monitoring of nitrogen, phosphorus, and biological responses.

8.6 Conclusions

The RBMP sets a clear environmental ambition: Albania must prevent deterioration, restore and protect water bodies, achieve good status or good ecological potential, protect groundwater resources, and meet the objectives of water-dependent protected areas. These objectives provide the policy anchor for monitoring, permitting, investment, restoration, and enforcement.

The current planning cycle should deliver two parallel results. First, it should implement practical measures that reduce the main pressures on surface waters, groundwater, and protected areas. Second, it should build the WFD-compliant technical system needed for future planning cycles: reference conditions, class boundaries, monitoring networks, priority substance monitoring, groundwater thresholds, environmental flow methods, protected area registers, and transparent status classification.

By combining immediate action with systematic capacity building, the RBMP can move Albania from strategic alignment with the WFD towards operational implementation in each river basin.

Water-dependent habitats and species require water conditions that support favourable conservation status. The RBMP therefore protects and, where necessary, improves the water environment to the extent needed for habitat and species conservation objectives. This is particularly important for

wetlands, floodplains, deltas, lakes, springs, and river reaches with high biodiversity value. Measures may include restoring hydrological regimes, reducing pollution, improving continuity, protecting groundwater discharge, managing sediment, and limiting physical disturbance.

Albania is still developing the Natura 2000 framework and related protected area information systems. The RBMP should therefore progressively improve the protected area register, map water-dependent habitats, and species, and align water management measures with protected area management plans.

8.7 How the RBMP applies the objectives in this planning cycle

This RBMP applies environmental objectives in a pragmatic but WFD-consistent way. It sets the direction of travel towards full WFD implementation while recognising current data and capacity constraints. The objectives are already binding as planning objectives, but the assessment methods, monitoring coverage and classification confidence will improve during implementation.

For this planning cycle, the RBMP applies the following implementation approach:

- use the current delineation of surface water bodies and groundwater bodies as the management units for objectives, monitoring, status assessment, and measures;
- apply the non-deterioration objective to all water bodies and protected areas;
- use available monitoring and expert judgement to identify pressures and provisional status where data remain incomplete;
- prioritise measures where pressures clearly prevent objective achievement, especially wastewater pollution, nutrient enrichment, hydro morphological alteration, abstraction pressure, and priority pollution risks;
- develop national reference conditions and class boundaries progressively, using new monitoring data, low-pressure sites, pressure-response analysis, and regional comparison;
- strengthen surface water monitoring for biological quality elements, general physico-chemical elements, hydro morphology, priority substances, and river basin specific pollutants;
- strengthen groundwater monitoring for levels, abstraction, springs, chemical status, threshold values, and trend assessment;
- develop environmental flow methods based on flow regimes and ecological needs, supported by re-established hydrometric data;
- complete and maintain the protected area register and align RBMP measures with protected area objectives;
- document uncertainties transparently and update classifications when new evidence becomes available.

9 MONITORING NETWORK AND DATA

This chapter presents the design, scope, and implementation of the basin's monitoring network in accordance with Annex V of the WFD. It describes monitoring programmes for surface water quantity and quality, groundwater, and protected areas. The chapter explains the selection of parameters, sampling frequencies, and station coverage. It also highlights data gaps and priorities for improvement, ensuring that monitoring results support reliable status classification, risk assessment, and adaptive management.

This chapter translates the technical framework, data collection and analysis presented and outlined in detail in the Task Reports 4a to 4f.

9.1 Legal Context

9.1.1 Albania

Albania's water monitoring responsibilities are currently distributed across several institutions, notably the Agency for Water Resources Management (AMBU), with the regional offices River Basin Administration Offices (RBAO), National Environment Agency (NEA), Institute of Geosciences (IGEO), Albanian Geological Survey (AGS), Institute of Public Health (IPH), Local Health Care Units (LHCU) and municipalities.

For groundwater bodies, monitoring and assessment must address two distinct status components:

- **chemical status**, in accordance with the Groundwater Directive (2006/118/EC);
- **quantitative status**, in accordance with the WFD.

For surface waters, monitoring must address:

- ecological status or ecological potential;
- chemical status;
- hydrological and hydro morphological supporting conditions;
- protected area objectives (drinking water, bathing water, Natura-type ecosystems where relevant).
- Inter-institutional data sharing obligations.

Under the WFD, monitoring is not a stand-alone technical exercise. It is the evidence base for pressure analysis, status classification, exemptions, Programmes of Measures, and compliance reporting. Strengthening the legal integration between monitoring institutions and planning authorities therefore remains a strategic priority for Albania.

Albania has advanced in water monitoring, but fragmented responsibilities hinder full WFD implementation and integrated river basin management. Mandates and reporting remain divided, leading to inefficiency.

Monitoring programs need consolidation to meet WFD standards—risk-based, water body-focused, and organized by surveillance, operational, and investigative goals. Lack of coordination in network design and data selection keeps systems sector-focused instead of prioritizing ecological status.

Institutional ownership is essential for accurate water assessments. Integration of datasets and standard methods is needed to avoid inconsistent or delayed results. Biological monitoring requires clearer roles for evaluating indicators such as phytoplankton and fish; effective monitoring depends on collaboration across institutions.

9.1.2 European Union

In accordance with the WFD, monitoring programmes are implemented as comprehensive systems designed to support the evaluation of water body status and inform the development of River Basin Management Plans. This approach necessitates a defined institutional structure, wherein designated competent authorities oversee implementation, supported by rigorous, quality-assured monitoring systems that promote data reliability, comparability, and adherence to EU standards. Furthermore, monitoring networks are required to be representative both spatially and temporally, reflecting variability across river basin scales. Assessment methodologies must be harmonised to ensure consistency of results across institutions and over time. Ultimately, these components are integrated within coordinated river basin reporting frameworks, enabling the translation of monitoring outcomes into effective planning and policy decisions.

EU legislation applies a comprehensive analytical approach to groundwater management by integrating monitoring with hydrogeological processes and ecosystem dynamics. The assessment of chemical status extends beyond general water quality indicators, targeting specific substances such as nitrates, pesticides, and other pollutants identified at the national level. This reflects both EU-wide influences and country-specific contamination challenges. Quantitative status evaluation addresses groundwater levels and the equilibrium between recharge and abstraction, which are essential for ensuring the long-term sustainability of aquifers and mitigating risks of over-exploitation.

Beyond status classification, monitoring must also detect significant and sustained upward trends in pollutant concentrations, which is essential for early warning and preventive management under the WFD's non-deterioration principle. Equally important is the assessment of interactions between groundwater and associated surface waters, since groundwater often plays a key role in sustaining river baseflow and ecological integrity during low-flow periods. Finally, monitoring must consider impacts on groundwater-dependent terrestrial ecosystems, which requires integrating hydrogeological data with ecological observations to evaluate whether changes in groundwater quantity or quality are affecting protected habitats and biodiversity.

9.2 Surface Water Quantity Monitoring Programme

9.2.1 Competent Authority

The primary institution responsible for surface water quantity monitoring in Albania is the Institute of Geosciences (IGEO), which operates the national hydrological and meteorological observation networks. Within this mandate, IGEO collects and processes core hydrological data, including river water levels, river discharge, precipitation, drought indicators, and flood-related parameters. These datasets provide the fundamental technical basis for national hydrological assessments and are used to support water allocation planning, drought preparedness, and flood risk management.

Despite this central role, current monitoring capacity remains below the requirements of the WFD, particularly in terms of spatial coverage, data continuity, and operational robustness. The system is constrained by ageing hydrometeorological infrastructure, insufficient operational budgets for maintenance and upgrades, and the use of outdated or fragmented databases that limit data integration and accessibility. In addition, telemetry coverage is still incomplete, reducing the ability to obtain near real-time hydrological information, while the availability of qualified hydrologists and data specialists remains insufficient to fully support modern analytical and modelling needs.

From the perspective of the WFD, hydrology alone does not sufficiently encompass the broader concept of hydro morphology, which requires an expanded institutional and analytical approach. Beyond discharge and water level monitoring, accountability should explicitly include river continuity, sediment transport processes, channel morphology, habitat structure, and ecological flow regimes. These components are vital to understanding the effects of physical river attributes on ecological status and to

ensuring that flow regulation and related infrastructure do not adversely impact river ecosystem functionality.

Meeting these requirements calls for enhanced inter-institutional coordination, encompassing IGEO, the National Environment Agency (NEA), river basin authorities, hydropower operators, civil protection entities, and applicable line ministries. This collaboration is especially vital in the Drin–Buna Basin, where hydrological dynamics are shaped by transboundary inflows, cascade hydropower management, and intricate downstream floodplain processes. Within this framework, comprehensive hydrological and hydromorphological monitoring becomes indispensable for effectively managing cumulative impacts throughout the basin and facilitating consistent, basin-wide decision-making aligned with WFD principles.

9.2.2 Relevance of the Surface Water Quantity Monitoring Network

An operational surface water quantity monitoring network is essential for the effective implementation of the WFD, the Floods Directive, and national drought resilience strategies. This network provides quantitative evidence base info/data necessary for ecological evaluations and risk management activities. Without dependable hydrological data, water management decisions are prone to being reactive and marked by uncertainty, especially in systems characterized by multiple, competing demands on shared resources.

The Drin–Buna Basin exhibits a heightened requirement for quantitative water allocation due to its highly complex and interconnected hydrological system. The basin encompasses the Black Drin and White Drin headwaters, significant transboundary lake systems including Ohrid, Prespa, and Shkodra, as well as the regulated Drin hydropower cascade, all of which collectively govern downstream flow regimes. Additionally, these components are linked to the Buna outlet system and extensive flood-prone lowland areas, where hydrological variability has a direct impact on local settlements, agricultural activities, and ecosystem stability. Concurrently, the basin experiences competing water demands from energy production, irrigation, ecosystem maintenance, and public water supply, resulting in quantitative water allocation being particularly sensitive to variations in flow.

A properly functioning monitoring network in this context must therefore go beyond basic discharge measurement and provide continuous, reliable information on multiple hydrological dimensions. This includes discharge trends and overall water availability, as well as the dynamics of low-flow conditions and drought development, which are critical for understanding water scarcity risks. It must also capture flood peaks and routing processes, particularly in regulated and cascade-influenced systems, where operational decisions can significantly alter flood timing and magnitude. Reservoir operation monitoring is equally important, given the strong influence of hydropower management on downstream hydrology.

Additionally, modern hydrological assessments aligned with the WFD require integration with both ecological and geomorphological processes. This includes the evaluation of ecological flow needs, sediment transport dynamics, and the impacts of long-term climate variability on hydrological regimes. Furthermore, due to the transboundary characteristics of the Drin–Buna system, the monitoring network should ensure consistent measurement of inflow and outflow across national borders, thereby supporting harmonized upstream and downstream water management strategies.

In the absence of a comprehensive and dependable hydrological monitoring system that accounts for these processes, achieving environmental protection goals and ensuring economically optimal water allocation remains uncertain. This is especially true in basins with stringent regulation, heightened ecological sensitivity, and diverse sectoral demands.

9.2.3 Status of the Surface Water Quantity Monitoring Network

The Albanian hydrometric network serves as a critical foundation for surface water monitoring; however, significant rehabilitation and modernization are necessary to align with WFD standards for water body-based assessment. Within the Drin–Buna Basin, historic hydrometric stations are established along principal rivers and lakes, offering valuable long-term hydrological data in certain locations. The Institute of Geosciences (IGEO) maintains institutional responsibility for their operation, leveraging its expertise

in flood monitoring and supplying essential data for hydropower system management. These attributes indicate that a fundamental monitoring framework exists and can effectively support targeted enhancements.

The current network's performance is considerably limited by structural and operational deficiencies, restricting its effectiveness for integrated basin management. A primary issue is the irregular spatial distribution of monitoring stations, which fails to accurately represent the water body delineation outlined by the WFD. Consequently, essential hydrological processes in headwater catchments, lake systems, regulated river segments, and downstream floodplains are not reliably incorporated into a unified monitoring framework.

Furthermore, numerous stations are impacted by aging infrastructure and partial equipment degradation, which undermines data reliability and increases the likelihood of gaps in long-term time series. Limited automation and telemetry systems exacerbate these challenges, resulting in restricted real-time or near real-time data availability across much of the basin. The ongoing dependence on manual or semi-manual data collection methods additionally limits temporal resolution, particularly during extreme events such as floods and droughts, when high-frequency data are essential.

A significant limitation pertains to the fragmentation of data management systems, which are not yet fully integrated with contemporary digital platforms. This fragmentation impairs the efficiency of data processing, validation, and institutional data sharing, thereby restricting the capacity for consistent basin-wide hydrological analysis. Additionally, staffing challenges—including shortages of specialised hydrologists, data analysts, and system maintenance personnel—further hinder both operational performance and the network's development potential.

Collectively, these shortcomings demonstrate that while the current hydrometric network offers a valuable historical dataset and serves as a robust institutional underpinning, it remains insufficient for supporting comprehensive WFD-compliant water body evaluations or sophisticated hydrological modelling. The primary challenges extend beyond infrastructure and encompass data management frameworks, monitoring technologies, and technical expertise within relevant institutions. These issues are especially significant in complex transboundary and highly regulated environments such as the Drin–Buna Basin.

To address these gaps, a comprehensive approach involving physical rehabilitation, digital transformation, and institutional capacity building is required. Key interventions include the systematic digitisation of data to safeguard and unify historical records, recalibration of stage–discharge curves to enhance flow measurement accuracy, and the installation of automatic telemetry stations for near real-time monitoring. Enhancing both low-flow and flood monitoring capabilities is essential for capturing hydrological extremes and climate variability. Concurrently, hydrological datasets should be integrated with ecological and water quality monitoring results to support pressure–impact-based assessments relevant to the WFD. Additionally, the development of basin-scale hydrological databases and integrated modelling tools is necessary to facilitate planning, allocation, and environmental status evaluation.

9.3 Surface Water Quality Monitoring Programme

9.3.1 Competent Authority

The National Environment Agency (NEA) is the lead competent authority for surface water quality monitoring in Albania. The National Environmental Monitoring Programme remains the legal basis for much of the operational monitoring network. NEA is responsible for:

- monitoring programme design and implementation;
- sampling and laboratory analysis;
- data validation and reporting;
- ecological and chemical status assessment;
- reporting under national legislation and EU approximation;
- coordination with basin authorities and other institutions..

Supporting institutions include:

- Albanian geological survey;
- IGEO (hydrology and meteorology);
- Institute of public health;
- Universities and research institutes (biology and taxonomy);
- Local authorities and utilities;
- Donor-funded projects.

NEA's monitoring system generally adheres to the principles of the EU WFD; however, its practical application continues to be predominantly station-based rather than fully aligned with a water body-based monitoring design as required by the WFD.

Existing capacity limitations substantially hinder both the effectiveness and sustainability of the system. Ongoing underfunding impacts all facets of monitoring, including field operations and laboratory analysis, while continual shortages of specialised personnel—such as hydrobiologists, chemists, and aquatic ecologists—impede the implementation of comprehensive programmes. Laboratory capabilities are restricted in terms of analytical scope, especially regarding priority substances and emerging pollutants, and accreditation remains incomplete, affecting compliance with WFD quality assurance standards. Furthermore, insufficient long-term staff retention compromises continuity, institutional memory, and the progressive development of technical expertise.

Biological monitoring constitutes a significant gap in current practice. The available internal expertise does not adequately support comprehensive biodiversity assessments across all necessary Biological Quality Elements, including macroinvertebrates, diatoms, macrophytes, and fish. Consequently, monitoring coverage for rivers, lakes, reservoirs, and coastal waters remains fragmented and primarily project-driven, rather than being integrated into a systematic, operational ecological monitoring framework consistent with WFD requirements.

9.3.2 Relevance of the Surface Water Quality Surveillance Monitoring Network

Surveillance monitoring, as defined under the EU WFD, is essential for providing a coherent, long-term overview of water status and identifying basin-wide trends. In a complex and highly regulated system such as the Drin–Buna Basin, its role is particularly critical.

Owing to its transboundary river systems, internationally significant lakes, major hydropower reservoirs, heavily utilized agricultural lowlands, and ecologically sensitive downstream and coastal regions, the basin necessitates a monitoring framework that surpasses isolated sampling sites and instead comprehensively addresses the spatial and functional continuity of the entire system.

To fulfil this role, surveillance monitoring must ensure representation of key hydrological and pressure gradients across the basin. This includes establishing robust reference conditions in minimally impacted upper basin waters, which are essential for ecological classification and trend detection. At the same time, monitoring must capture transboundary inflows, where upstream activities outside national jurisdiction influence water quality and ecological status.

The evaluation of cumulative pressures along the river continuum is crucial. As water moves downstream, it accumulates diverse impacts from agricultural activities, urban effluents, and industrial processes, necessitating strategically placed monitoring sites to observe the progression or improvement of water quality. Within the Drin–Buna system, it is essential to carefully consider the effects of hydropower reservoirs, which substantially modify flow patterns, sediment dynamics, and ecological conditions, thereby introducing discontinuities that warrant targeted monitoring.

Surveillance monitoring must possess the capability to identify and track pollution hotspots, including those associated with urban and industrial discharge areas, as well as to detect long-term ecological variations resulting from climate variability, land use transformation, and hydrological modification. A strategically designed monitoring network is essential for the basin to achieve a reliable, WFD-compliant assessment of status and trends, thereby establishing a basis for effective river basin management planning.

Recent field campaign confirms 10 representative stations:

Table 33 - 10 representative stations in the Drin-Buna basin.

ID	STATION	STRATEGIC ROLE
S1	Drin i Zi upstream	Transboundary inflow
S2	Drin i Zi downstream	Upstream impact zone
S3	White Drin upstream	Kosovo inflow
S4	White Drin downstream	Mining/geology influence
S5	Fierza	Reservoir mixing
S6	Koman	Lake system
S7	Buna downstream	Cumulative outlet
S8	Drin downstream	Pre-confluence
S9	Buna upstream	Lake Shkodra influence
S10	Drin Lezhë	Hotspot system

Without surveillance monitoring, reliable WFD classification and prioritisation of measures are not possible.

9.3.3 Status of the Surface Water Quality Surveillance Monitoring Network and Data

The current monitoring network in the Drin–Buna Basin offers a significant operational and historical framework. Nevertheless, it is not yet completely harmonised with the EU WFD, especially regarding integrated assessment based on water bodies.

Assessment of available data indicate three broad basin zones:

1. upper basin – relatively good conditions;
2. middle basin – nutrient and organic pressure;
3. lower basin – strongest cumulative pressures, particularly Drin–Lezhë.

Table below gives the status assessment based on monitoring data series during the period 2019-2025 along the Drin-Buna river basin. The monitoring stations include the existing sampling points periodically monitored by NEA and the additional monitoring stations monitored by the expert project team. The parameters used for the chemical status assessment of the water bodies are limited to physico-chemical and some heavy metals. The priority substances have not been monitored so far.

Table 34 - Water Quality Chemical Status - Monitoring Period 2019-2025.

Waterbody name	SWB Code	Monitoring Station	Status P-CHEM ⁸⁷	Status ANNEX X PSS ⁸⁸	Status Heavy Metals	Overall STATUS
Liçeni i Fierzës	LW3510701	Fierza	2		5	3
Liçeni i Komanit	LW3510301	Koman	2		5	2
Liçeni i Shkodrës	LW3510201	Buna upstream	2		5	3
Lumi i Bunës	TW3510101	Buna upstream	2		5	3
Lumi i Lumës	351084	White Drin downstream	4		5	43
Lumi i Bunës downstream	35101	Buna downstream	2		5	3
Lumi Drini i Zi - 1	3510973	Drin i Zi upstream	2		5	3
Lumi Drini i Zi nderkufitar	351099	Drin i Zi upstream	2		5	3
Lumi Drini i Zi - 6	351091	Drin i Zi downstream	2		5	3
Lumi Drini i Bardhe	351082	White Drin upstream	3		5	43
Lumi i Drinit të Lezhës, poshtëm		35111	Drin Lezhë	4		5
Lumi i Bunës - Liçeni Shkodres	351021	Buna upstream	2		5	3
Lumi Drin - Ashte	3510321	Drin downstream	2		5	3

⁸⁷ Physico-chemical parameters

⁸⁸ Priority substances

Current status assessments remain transitional because ecological classification still relies heavily on physic-chemical indicators and some heavy metals, while routine Biological Quality Element (BQE) monitoring is lacking.

However, indicatively the surface waterbodies where the monitoring stations are located fall under 3rd and 4th status category, showing “moderate” or “poor” waterbody status.

Several notable strengths are evident. Multi-year nutrient and oxygen regime datasets serve as a robust foundation for trend analysis, while ongoing physico-chemical monitoring facilitates consistency in essential parameters. The network demonstrates spatial balance through strategic coverage of both upper and lower basin areas, thereby enabling effective pressure-impact assessments. Recent pilot biological surveys mark a significant advancement toward comprehensive ecological status evaluation, and the broader screening of heavy metals in recent campaigns has enhanced insight into primary pollution pressures. Collectively, these approaches have enabled more accurate identification of pollution hotspots throughout the basin.

At the same time, several critical gaps continue to limit full WFD compliance. Biological monitoring remains the most significant deficiency, as routine and systematic assessment of Biological Quality Elements—macroinvertebrates, fish, macrophytes and phytoplankton—is still absent or irregular. Chemical monitoring is also incomplete, with only a subset of WFD priority substances currently included, preventing a comprehensive chemical status classification. Hydro morphological monitoring is largely undeveloped, with no systematic assessment of flow alteration, sediment continuity or habitat condition, despite their central role in ecological status.

Data management poses a structural challenge, as monitoring data are distributed across disparate databases with minimal integration into GIS platforms. Quality assurance and control procedures remain unstandardised. These technical issues are further exacerbated by institutional capacity limitations, such as restricted human resources, deficiencies in specialised expertise, and inadequate laboratory infrastructure to meet expanded analytical needs.

A comprehensive approach is required to address these challenges. To improve representation of water bodies and pressure gradients, monitoring coverage and sampling frequency should be expanded. Institutionalising biological monitoring as a fundamental element of the system is necessary, transitioning from pilot studies to routine application across all pertinent water categories. Chemical monitoring must also be extended to encompass the complete range of WFD priority substances.

Development and integration of hydro morphological assessment into established monitoring programmes are needed. Concurrently, investment in integrated data management systems will ensure consistency, accessibility, and rigorous quality control of monitoring data. The creation of national ecological classification tools is essential for achieving uniform and WFD-compliant status assessments throughout the basin.

9.3.4 Biological field surveys

Diatoms surveys undertaken in 2020, 2024 in the frame of PhD studies and research activities, Albanian Agricultural University and followed in 2025 with the monitoring campaign carried out in the frame of EU4 Rivers Project, represented an important first step toward ecological assessment under the WFD.

The surveys confirmed:

- better biological quality in upper reaches;
- degraded communities in impacted downstream reaches;
- influence of organic pollution and habitat simplification;
- need for Albanian reference conditions and class boundaries.

These surveys were project-based and should be converted into permanent national monitoring programmes.

Ecological status assessment has been carried out taking into consideration two BQEs according to WFD, diatoms and macroinvertebrates.

Tables below show a summary of status assessment per monitoring station based on indices calculated respectively for diatoms and macroinvertebrates.

Table 35 - Ecological status assessment based on BQEs (diatoms) during 2020-2025.

Surface Waterbody	SWB Code	Monitoring Station	STATUS BQES Diatoms	OVERALL SATUS
Liqeni i Ohrit	LW3510903	Oher_Lin	3	3
		Oher_Piskupat	2	
		Oher_Gur i Kuq	2	
		Oher_Pogradec, (Verdova River)	3	
		Oher_Drilon	2	
Liqeni i Shkodrës	LW3510201	Hani I Hotit (Bajze)	2	2
		Sterbeq	2	
		Shiroka (Arbri Restaurant)	2	
		Zogaj	2	

Status assessment of the surface waterbodies under category “Lakes” has been performed considering monitoring of diatoms for the year 2020, 2024 and 2025. Despite the number of sampling sites within a waterbody, the monitoring of diatoms remains limited and not sufficient for a proper waterbody status assessment as required by the WFD. However, indicatively the status of Ohrid Lake falls under 3rd category, having a moderate quality status, while Shkodra Lake, falls under 1-2 category, representing a good status.

Table 36 - Ecological status assessment based on BQEs (macroinvertebrates) during 2019-2025.

Surface Waterbody	SWB Code	Monitoring Station	Status BQE - Macroinvertebrates	OVERALL SATUS
Liqeni i Ohrit	LW3510903	Oher_Lin		3

9.3.5 Hydro-Morphological assessment

Hydro morphological monitoring is currently the least developed component of WFD implementation. Institutional responsibility remains fragmented. IGEO covers hydrology, while other institutions have partial expertise in morphology or engineering data, but no single authority is formally mandated for full hydro morphological assessment.

Hydro morphological pressures within the Drin–Buna Basin represents some of the most significant influences on ecological status; however, they are the least systematically monitored component under the current framework aligned with the EU WFD.

The basin is substantially affected by hydropower regulation, which alters natural flow patterns and diminishes seasonal variability critical to ecosystem integrity. Physical barriers such as dams and weirs disrupt longitudinal connectivity, impeding fish migration and causing fragmentation of aquatic habitats. Reservoirs retain sediments, resulting in downstream sediment deficits, channel incision, and substrate armouring.

Sediment trapping by reservoirs, combined with river training works, bank protection, historical straightening, and other anthropogenic disturbances, contributes to channel narrowing, incision, and reduced lateral connectivity with floodplains in several reaches of the basin. These processes simplify channel morphology, reduce habitat heterogeneity, alter substrate composition, and diminish ecological functionality. In some reaches, armouring and excessive fine sediment deposition have also been observed, affecting spawning habitats, benthic communities, and overall riverine ecological conditions.

Further pressures—including channel modification, gravel extraction, and floodplain disconnection—degrade river morphology and reduce habitat diversity. In downstream and lowland regions, shoreline alteration and wetland degradation contribute to the loss of ecologically valuable transitional habitats.

A structured hydro morphological monitoring and assessment program is essential to address these pressures. The initial phase should involve a systematic evaluation of flow regime modifications, considering the magnitude, timing, and frequency of regulated flows. Thorough inventories of barriers and continuity disruptions are vital for assessing river connectivity and identifying priorities for restoration.

Recent hydro-morphological assessment approaches increasingly apply geomorphology-based methodologies that evaluate pressure–response relationships within river systems. Unlike conventional physical habitat surveys, which are often limited to fixed spatial scales and descriptive habitat characterization, methodologies such as the Morphological Quality Index (MQI) and Hydro-Morphological Quality Index (HMQI) assess both anthropogenic pressures and geomorphological responses. This approach supports a more comprehensive understanding of river functioning, channel evolution, sediment continuity, and ecological implications, consistent with the requirements of the WFD. Existing assessments within the Drin–Buna River Basin indicate predominantly poor hydro-morphological quality in Partly Confined and Unconfined water bodies, particularly in heavily regulated downstream sections affected by hydropower infrastructure and channel modification.

Field-based habitat surveys must be conducted to delineate channel structure, substrate composition, and habitat diversity, supported by riparian condition mapping to assess bank stability, vegetation coverage, and land use impacts. Sediment continuity analysis is crucial for understanding transport dynamics and diagnosing critical imbalances resulting from reservoir trapping.

For lakes and reservoirs, shoreline assessments should address hydro morphological changes, water level variability, and habitat conditions. These evaluations can be effectively facilitated through GIS and remote sensing technologies, allowing comprehensive basin-wide identification of morphological impacts and prioritisation of advanced surveys.

In addition, downstream environmental flow assessments at dam sites are essential for determining flow regimes that support ecological functions while accommodating hydropower generation and water supply requirements. Collectively, these elements establish a robust, WFD-compliant hydro morphological programme that underpins ecological status classification and targeted river basin management strategies.

Hydro morphological restoration will be especially important in the middle and lower Drin and in the Buna floodplain system.

Existing MQI/HMQI assessments demonstrate that hydro-morphological conditions are generally poorer in Partly Confined and Unconfined River reaches, where hydropower regulation, sediment discontinuity, and channel modification exert stronger pressures. In contrast, Confined river systems typically retain moderate to good hydro-morphological quality due to stronger natural controls and comparatively lower anthropogenic alteration.

Table 37 - Drin–Buna RBMP – Hydro-Morphological Quality.

Name of Water bodies	Sub basins	PC-U	MQI	MQI Class of quality	HMQI	HMQI Class of quality
Lumi i Veleshices	Drini i Zi	PC	0,67	MODERATE	0,58	MODERATE
Lumi Cemi i Selces	Drin – Bunë	PC	0,71	GOOD	0,63	MODERATE
Lumi Drini i Bardhe	Kaskada Drinit	U	0,48	POOR	0,40	POOR
Lumi Drini i Zi - 1	Drini i Zi	U	0,34	POOR	0,26	BAD
Lumi Drini i Zi - 2	Drini i Zi	U	0,32	POOR	0,23	BAD
Lumi Drini i Zi - 3	Drini i Zi	U	0,37	POOR	0,29	BAD
Lumi Drini i Zi - 4	Drini i Zi	U	0,33	POOR	0,24	BAD
Lumi Drini i Zi - 5	Drini i Zi	U	0,34	POOR	0,26	BAD
Lumi Drini i Zi - 6	Drini i Zi	U	0,39	POOR	0,31	POOR
Lumi Drini i Zi nderkufitar	Drini i Zi	U	0,41	POOR	0,33	POOR
Lumi i Bunës - Ligeni i Shkodres	Drin – Bunë	U	0,42	POOR	0,33	POOR
Lumi i Bunës downstream	Drin – Bunë	U	0,39	POOR	0,30	POOR
Lumi i Cemit te poshtem	Drin – Bunë	PC	0,61	MODERATE	0,52	MODERATE
Lumi i Drinit te Lezhes,poshtem	Drin – Bunë	U	0,30	BAD	0,30	BAD
Lumi i Drinit te Lezhes,siperm	Drin – Bunë	U	0,37	POOR	0,37	POOR

Name of Water bodies	Sub basins	PC-U	MQI	MQI Class of quality	HMQI	HMQI Class of quality
Lumi i Gjadërit	Kaskada Drinit	U	0,36	POOR	0,36	POOR
Lumi i Gjadërit, Lezhe	Drin - Bunë	U	0,43	POOR	0,43	POOR
Lumi i Kirit, rrjedha e poshtme	Drin - Bunë	U	0,36	POOR	0,36	POOR
Lumi i Selës	Drini i Zi	U	0,39	POOR	0,39	POOR
Lumi i Valbones ne rrjedhen e poshtme	Kaskada Drinit	U	0,34	POOR	0,34	POOR
Lumi Molla e Lures	Drini i Zi	U	0,36	POOR	0,36	POOR
Lumi Zalli i Bulquzes	Drini i Zi	U	0,36	POOR	0,36	POOR
Përroi i Murres	Drini i Zi	U	0,39	POOR	0,39	POOR
Perroi i Thate	Drin - Bunë	U	0,36	POOR	0,36	POOR
Perroi i Varkes	Drin - Bunë	U	0,39	POOR	0,39	POOR
Lumi Drin - Ashte	Kaskada Drinit	PC	0,45	POOR	0,36	POOR
Lumi Drin - Kir - Bune	Kaskada Drinit	U	0,45	POOR	0,45	POOR
Lumi i Bushtices	Drini i Zi	C	0,66	MODERATE	0,66	MODERATE
Lumi i Sapaçit	Kaskada Drinit	C	0,73	GOOD	0,73	GOOD
Lumi i Shalës	Kaskada Drinit	C	0,81	GOOD	0,81	GOOD
Lumi i Thethit	Kaskada Drinit	C	0,80	GOOD	0,80	GOOD
Lumi i Bushtices	Kaskada Drinit	C	0,61	MODERATE	0,52	MODERATE
Lumi i Cemit te siperm	Drin – Bunë	C	0,54	MODERATE	0,54	MODERATE
Lumi i Currajt	Kaskada Drinit	C	0,73	GOOD	0,73	GOOD
Lumi i Dardhës	Kaskada Drinit	C	0,63	MODERATE	0,54	MODERATE
Lumi i Gashit	Kaskada Drinit	C	0,88	HIGH	0,79	GOOD
Lumi i Gomsiqes	Kaskada Drinit	C	0,64	MODERATE	0,64	MODERATE
Lumi i Kirit, rrjedha e sipërme	Drin - Bunë	C	0,61	MODERATE	0,52	MODERATE
Lumi i Krumës	Kaskada Drinit	C	0,66	MODERATE	0,57	MODERATE
Lumi i Lumës	Kaskada Drinit	C	0,61	MODERATE	0,52	MODERATE
Lumi i Mashit	Kaskada Drinit	C	0,61	MODERATE	0,52	MODERATE
Lumi i Valbones ne rrjedhenrrjethen e mesme	Kaskada Drinit	C	0,78	GOOD	0,78	GOOD
Lumi i Valbones ne rrjedhen e sipërme	Kaskada Drinit	C	0,78	GOOD	0,69	MODERATE
Lumi i Vermoshit	Drin - Bunë	C	0,64	MODERATE	0,56	MODERATE
Perroi i Kalimashit	Kaskada Drinit	C	0,62	MODERATE	0,62	MODERATE
Perroi i Seriqes	Kaskada Drinit	C	0,72	GOOD	0,72	GOOD
Perroi i Skatines	Kaskada Drinit	C	0,72	GOOD	0,63	MODERATE
Perroi i Runices	Danub	C	0,82	GOOD	0,73	GOOD

9.4 Groundwater Monitoring Programme

9.4.1 Competent Authority

The Albanian Geological Survey (AGS) is the competent institution for groundwater monitoring and assessment. AGS is responsible for:

- groundwater body investigations;
- hydrogeological assessments;
- groundwater level monitoring;
- chemical monitoring;
- groundwater status assessment.

AGS laboratory capacity covers a broad range of standard physico-chemical parameters, but capacity for pesticides, Polycyclic Aromatic Hydrocarbons (PAHs) and other organic micropollutants remains limited.

Water utilities also collect operational data on abstractions, well levels and raw water quality. These datasets are highly relevant for groundwater status assessment and should be formally integrated with AGS systems.

9.4.2 Relevance of the Groundwater Quantity Monitoring Network

Monitoring groundwater quantity in the Drin–Buna Basin is critical for assessing whether groundwater bodies meet the quantitative standards established by the EU WFD. This process forms the foundation for evaluating resource sustainability and understanding the dynamics between groundwater and associated ecosystems.

One primary objective is to evaluate long-term trends in groundwater levels. Consistent and accurate water level monitoring is essential for detecting reductions, recovery dynamics, and variations associated with climatic factors or extraction activities. This analysis is fundamental to understanding recharge mechanisms and responses to drought, especially in basins where seasonal fluctuations and climate change significantly affect groundwater replenishment.

Effective monitoring should quantitatively assess the effects of abstraction, verifying that water withdrawals for irrigation, public supply, and industrial uses remain within sustainable limits and do not result in prolonged drawdown. Additionally, coastal and lowland regions require heightened scrutiny regarding saline intrusion risks, as excessive abstraction may cause saline water to infiltrate freshwater aquifers.

An additional critical function of groundwater monitoring is to assess its role in supporting surface and terrestrial ecosystems. This includes sustaining springs, wetlands and river baseflow, especially during dry periods when groundwater contributions are essential for maintaining ecological flows. In the Drin–Buna Basin, this is particularly relevant for maintaining hydrological and ecological continuity along river systems.

Effective monitoring must address the intricate hydrogeological interactions present in the region, such as exchanges between groundwater and lakes and the prevalence of karst systems. These karst systems frequently demonstrate rapid flow paths and substantial hydraulic connectivity, necessitating the implementation of well-structured monitoring networks to accurately reflect their dynamic behaviour. Collectively, these considerations underpin a thorough and WFD-compliant evaluation of groundwater quantity status.

This is particularly relevant for the Ohrid, Prespa and connected karst systems. The carbonate water-bearing complexes of Pogradec, Lini, Tushemisht, Tropoja, Kukes and Kruma demonstrate strong hydraulic connectivity and locally developed karst circulation, making them highly sensitive to rapid pollutant transport and short-term hydrodynamic variations. Springs such as Syri i Sheganit, Lini and Tushemisht represent strategic groundwater-dependent resources that require continuous quantitative and qualitative monitoring, including discharge regime assessment and protection-zone management.

Current monitoring frequencies of only 2 to 4 times per year at some sites are generally insufficient for robust trend analysis.

9.4.3 Status of the Groundwater Quantity Monitoring Network and Data

Groundwater quantity monitoring within the Drin–Buna Basin is currently fragmented and does not yet yield a comprehensive view at the groundwater body scale as mandated by the EU WFD.

The principal deficiencies are structural and operational in nature. Monitoring points are distributed unevenly, resulting in significant aquifers and hydrogeological units being insufficiently represented. The current quantitative monitoring network is concentrated mainly within the Shkodra alluvial–Quaternary aquifer system, while important groundwater units in Nënshkodër–Zadrimë, Pogradec, Tropoja, Kukës and Peshkopia remain poorly represented. At basin scale, only a limited number of hydrodynamic monitoring points are available for continuous groundwater-level assessment, which is insufficient considering the hydrogeological complexity and spatial extent of the basin.

Several observation sites are either inactive or subject to intermittent monitoring, which leads to discontinuous time series and restricts the ability to conduct robust trend analyses. The frequency of measurements is generally low, thereby impeding the capture of seasonal variations and short-term responses to recharge or abstraction events. Existing monitoring programmes commonly rely on only two measurement campaigns per year, which provide an indicative overview of groundwater conditions but remain insufficient for capturing short-term hydrodynamic fluctuations, extreme recharge events, drought conditions and the impacts of intensive abstraction. In addition, the current hydrodynamic network mainly represents the Shkodra alluvial–Quaternary aquifer system, while strategic carbonate springs and groundwater systems in Nënshkodër–Zadrimë, Pogradec, Tropoja, Kukës and Peshkopia remain inadequately monitored.

Deployment of automatic level loggers remains limited, affecting both data resolution and reliability. Furthermore, abstraction data—which are essential for quantitative status assessment—are still inadequately incorporated within the monitoring framework. Automatic monitoring currently exists mainly at the Dobraç wellfield, where groundwater-level fluctuations, temperature and electrical conductivity are continuously recorded. Monitoring data indicate seasonal amplitudes of approximately 2–5.5 m within the Shkodra aquifer system, demonstrating the importance of continuous measurements for understanding recharge dynamics, abstraction impacts and seasonal groundwater variability.

Resolving these challenges necessitates the adoption of a contemporary, continuous, and cohesive monitoring framework. Prioritizing the deployment of automatic groundwater level loggers at key observation locations will facilitate frequent data acquisition and enhance comprehension of temporal fluctuations. At selected strategic points, integrating telemetry systems will enable nearly real-time data transmission, thereby optimizing network management.

Equally crucial is incorporating abstraction metering within the monitoring strategy to systematically document groundwater extraction and correlate it with observed water level dynamics. Enhancing analytical capabilities is essential for evaluating recharge mechanisms and drought responses, supported by long-term datasets and climate variables.

It is essential that monitoring programmes systematically incorporate groundwater–surface water interactions, especially in regions where groundwater influences river baseflow, sustains wetlands, or engages with lakes and karst systems. Special focus should be given to strategic carbonate springs such as Tushemisht, Lini, Quku i Dunishës, Gurra e Kolosianit and Gurra e Krumës, where regular discharge monitoring is currently limited despite their importance for public water supply, groundwater-dependent ecosystems and regional water balance assessment.

Enhancing these elements will facilitate a comprehensive and WFD-compliant evaluation of groundwater quantitative status, thereby promoting effective and sustainable resource management throughout the basin.

9.4.4 Status of the Groundwater Quality Monitoring Network and Data

Groundwater quality monitoring within the Drin–Buna Basin presently emphasizes standard physico-chemical parameters, offering a fundamental overview of prevailing water quality conditions. Nevertheless, this methodology does not fully address the comprehensive criteria stipulated by the EU WFD and the Groundwater Directive.

One major limitation is the narrow scope of pollutant coverage. Routine monitoring programs rarely include pesticides, organic micropollutants, and emerging contaminants, despite their growing importance in agricultural, urban, and industrial environments. Existing groundwater quality monitoring is focused mainly on standard physico-chemical parameters such as pH, major ions, mineralization, ammonium, nitrates and nitrites. Monitoring results generally indicate good groundwater quality in both alluvial–Quaternary and carbonate complexes; however, localized pollution indicators have been identified in parts of the Shkodra–Nënshkodër–Zadrimë aquifer system, particularly elevated NH_4 , NO_2 and episodic NO_3 concentrations associated with insufficient sanitary protection, flood influence and proximity to drainage channels. As a result, there are considerable gaps in assessing chemical impacts on groundwater, especially within heavily exploited lowland aquifers and sensitive hydrogeological settings such as karst systems. Existing hydrochemical monitoring nevertheless indicates localized water-quality pressures in parts of the Shkodra–Nënshkodër–Zadrimë alluvial–Quaternary aquifer system. Elevated NH_4 concentrations have been observed in Blinisht, Velipojë, Hot i Ri and Grudë–Fushë, while sporadic NO_2 occurrences have been identified in Blinisht and Velipojë. In Grudë–Fushë, episodes of increased NO_3 concentrations have also been recorded. These pressures are generally associated with insufficient sanitary protection, flood influence, drainage channels and local anthropogenic activities near abstraction points.

To enhance the effectiveness of future monitoring programmes, a risk-based and targeted approach is recommended. Attention should be focused on major production wells supplying public water, critical springs—particularly those that support ecosystems or serve as sources of drinking water—and aquifers

classified as susceptible to contamination. Priority monitoring locations should include the Dobraq wellfield, strategic alluvial abstraction zones in Nënshkodër–Zadrimë, and major carbonate springs such as Tushemisht, Lini, Syri i Sheganit, Gurra e Krumës and Radomira, which are essential for public water supply and groundwater-dependent ecosystems. This strategy would increase both the representativeness and significance of collected monitoring data. Additional attention should also be given to Berdicë, where elevated magnesium concentrations and higher groundwater hardness indicate the need for continued hydro chemical follow-up and improved understanding of local hydrogeochemical conditions.

Furthermore, monitoring activities must be designed to facilitate the detection of notable and sustained upward trends in pollutant concentrations, in accordance with the requirements set forth by the Groundwater Directive. Available hydrogeological assessments indicate that groundwater exploitation within the Drin Basin is concentrated primarily in the Shkodra and Nënshkodër–Zadrimë alluvial–Quaternary complexes, where exploitation coefficients are estimated at approximately $K = 0.33$ – 0.5 and $K \approx 0.5$ respectively. However, comparable hydraulic indicators for major carbonate groundwater systems are still lacking, limiting the possibility of fully assessing groundwater quantitative status at groundwater-body scale.

Achieving this objective requires the establishment of consistent time series, selection of relevant parameters, application of rigorous analytical methodologies, and integration with pressure data such as land use, agricultural activities, and point source discharges. Enhancing these components will be crucial for conducting a thorough and compliant assessment of groundwater chemical status. Monitoring networks should also be progressively linked to delineated groundwater bodies and harmonized with WISE/INSPIRE reporting requirements. Future groundwater characterization should systematically include hydraulic indicators such as exploited discharge (Q), exploitation coefficient (K), transmissivity (T), filtration coefficient (k), specific discharge (q), aquifer thickness and monitoring-network density to support robust quantitative and chemical status assessments.

Albania still needs to establish national threshold values for pollutants relevant to its hydrogeological conditions, including salinity indicators, metals and regionally significant contaminants. Overall, the current monitoring framework provides a valuable baseline for the Shkodra aquifer system but remains insufficient for comprehensive groundwater-body scale assessment across the wider Drin–Buna Basin.

9.5 Protected Areas Monitoring Programmes

9.5.1 Competent Authorities

Article 8 of the WFD requires monitoring programmes for water bodies to ensure a comprehensive overview within each river basin district. In the Drin – Buna River Basin, this is crucial due to various protected zones such as drinking water sources, bathing areas, fisheries, Ramsar wetlands, national protected sites, and sensitive ecosystems.

Law No. 29/2024 on Water Resources aligns Albania’s legal framework with WFD Article 6 and Annex IV, enabling the creation of a Protected Areas Register and integration of environmental goals into River Basin Management Plans (RBMPs). Despite legal progress, monitoring systems remain fragmented and underdeveloped.

Protected areas relevant to WFD implementation include:

- drinking water protected areas;
- bathing waters;
- nutrient-sensitive zones;
- fisheries waters;
- habitats and species protection areas.

In areas designated for drinking water protection—primarily hygienic and sanitary zones surrounding groundwater springs and wells—monitoring efforts are concentrated on regular physico-chemical and

microbiological quality assessments conducted by water utilities and public health authorities. These checks are mostly confined to publicly managed abstraction points, whereas privately owned wells are typically excluded from systematic monitoring. The lack of a comprehensive, spatially referenced registry of protection zones results in inconsistent mapping and coordination of monitoring sites between institutions, thereby limiting the effectiveness of compliance verification and risk assessment at the basin level.

Within areas designated for the conservation of economically significant aquatic species—including fisheries co-management zones such as Lake Shkodra–Buna and Prespa Lakes—monitoring activities are primarily concentrated on fisheries management. These efforts address fish stocks, spawning conditions, and enforcement of fishing restrictions. Nevertheless, ecological monitoring of related factors, including habitat quality, hydrological conditions, and aquatic invertebrates, remains limited. Consequently, biological and hydro morphological influences on fish population status are not comprehensively evaluated under a unified monitoring framework.

Recreational and bathing waters are subject to seasonal monitoring, primarily through bacteriological sampling at specified coastal locations, including Velipojë, Shëngjin, and Divjakë–Seman. Although this approach offers essential public health protection during the bathing season, the frequency of monitoring is limited and spatial coverage is restricted. Furthermore, pressures in upstream catchment areas arising from wastewater discharge, agricultural activities, and urban runoff are not consistently incorporated into bathing water assessments, resulting in only partial understanding of pressure-impact relationships.

Formal designation of nutrient-sensitive and vulnerable areas—including those typically identified under nitrate or urban wastewater sensitivity criteria—has not yet been finalised within the basin. As a result, these zones currently lack dedicated monitoring programmes; instead, evaluations of nutrient pressure are inferred from general river monitoring stations rather than specialised surveillance networks.

Nature conservation areas—including Ramsar wetlands and nationally protected regions such as the Shkodra Lake and Buna River wetland system—are monitored for biodiversity primarily by protected area authorities and through project-based efforts. These activities typically involve periodic habitat surveys, avian monitoring, and limited water quality assessments. Nevertheless, comprehensive ecological monitoring of all Biological Quality Elements, as mandated by the WFD, is not consistently executed across these sites. Additionally, hydro morphological pressures—including shoreline modification, sediment transport, and floodplain disconnection—remain inadequately monitored.

Across all categories of protected areas, the primary challenge is the lack of an integrated monitoring framework connecting water quality, biological state, and hydro morphological conditions. Institutional roles are distributed among several agencies, resulting in fragmented data systems, minimal GIS integration, and limited interoperability. Consequently, protected areas are not monitored as a cohesive unit at the river basin level, and their ecological status cannot be reliably evaluated according to WFD standards.

9.5.2 National Monitoring and Reporting to the European Commission

Under the WFD, monitoring data help classify ecological and chemical status, assess risks, check compliance in protected areas, and track progress toward environmental goals. Albania, as an EU candidate, is gradually aligning its systems with European Commission standards.

Nationally, Albania reports environmental data through annual reports, EU accession screenings, river basin planning, and sectoral reporting for bathing water, biodiversity, and wastewater.

Protected area reporting includes drinking water zones, bathing water quality, habitat and species conditions, nitrate area monitoring, and effectiveness of measures. Currently, Albania lacks a fully integrated WFD-compliant platform, and data are fragmented and project-based.

For the Drin-Buna Basin, reporting relies mainly on general water quality stations, occasional bathing water assessments, protected area biodiversity checks, and targeted surveys like EU4Rivers. Thus,

protected area reporting is incomplete and does not yet fully meet WFD Article 8 and Annex V requirements.

9.5.3 Operational Status of the Protected Areas Monitoring Networks in Drin-Buna

Monitoring of protected areas within the Drin–Buna Basin is currently fragmented and has yet to be established as a unified, WFD-compliant system encompassing all types of protected water-dependent sites. Existing programmes should be integrated into basin monitoring systems, particularly for:

- Lake Ohrid;
- Lake Shkodra/Skadar;
- Buna delta wetlands;
- Adriatic bathing waters;
- Drinking water abstraction zones.

9.6 Transboundary monitoring Programmes

Surface water monitoring in the Drin-Buna River Basin is carried out by the national hydrometeorological services of the riparian countries: IGEO in Albania, HMS in North Macedonia, KHMI in Kosovo and IHMS in Montenegro. At present, there is no fully unified basin-wide transboundary monitoring network for surface water quantity. Monitoring remains organised mainly at national level, with differences in station density, parameters, equipment, data continuity, rating curves, data management and access. This limits the ability to produce a consistent basin-wide assessment of hydrological regime, flow alteration, flood and drought risk, sediment dynamics and water availability.

Cooperation has improved under the Drin Memorandum of Understanding and the Drin Core Group. The Drin cooperation process includes expert groups on the WFD, monitoring and information exchange, biodiversity and floods. The objectives of the Drin MoU include improving access to comprehensive data, reducing flood risk, controlling pollution and reducing damage from hydromorphological changes⁸⁹ The GEF Drin Project and the Transboundary Diagnostic Analysis (TDA) provided an important basis for joint assessment. Two basin-wide monitoring campaigns were implemented in 2016 and 2017 and represented the first coordinated monitoring exercises across the whole Drin Basin. The TDA also identified the lack of adequate hydrological monitoring and data management as a key underlying limitation for transboundary water management.

In **Albania**, the Drin Basin contains a relatively extensive hydrological and meteorological monitoring network, including stations on the Drin River, its tributaries and the Buna catchment. Meteorological monitoring is considered more developed than hydrological monitoring. Hydrological monitoring still requires improvement in relation to station coverage, rating curves, data processing and data management. A further limitation is the restricted exchange of operational hydrological data from hydropower companies, especially for the Drin Cascade, although these data are essential for understanding flow regulation, reservoir operation and downstream flood and low-flow conditions.

In **North Macedonia**, monitoring in the Black Drin sub-basin is limited and strongly influenced by lake and hydropower regulation. Several former hydrometric stations are no longer operational, and the available hydrological data series contain gaps and inconsistencies. Rating curves, staffing, equipment and budget constraints remain important limitations. The national electricity company operates additional monitoring stations near dams, but these data are not yet fully integrated into a common basin-wide monitoring framework.

In **Kosovo**, hydrometric monitoring in the White Drin sub-basin has a long history, but the network was severely damaged during the 1999 conflict and has only partly been rebuilt. Although several stations are technically capable of monitoring water level, temperature and water-quality parameters, only a small number are operational. Rating curves need updating, precipitation monitoring is incomplete, and data management is constrained by limited staff, budget and digital infrastructure. These weaknesses

⁸⁹ <https://gwp-gwp.org/stories-of-change/europe-stories-of-change/enabling-transboundary-co-operation-and-integrated-water-resources-management-in-the-extended-drin-river-basin/>

are particularly relevant because the White Drin contributes important inflows, sediment loads and potential pollution loads to the Albanian Drin system.

In **Montenegro**, monitoring in the Shkodra and Buna watersheds is relatively stronger. Several hydrological stations monitor water level, discharge and, in some cases, water temperature, and a number of stations transmit data automatically. Historical data are available for several stations, although discharge records are less complete than water-level records and more recent time series are scattered. The meteorological network includes precipitation, climatological and automatic stations. Compared with the other riparians, Montenegro's hydrometric monitoring system is considered relatively well developed.

At basin scale, hydrological modelling under the Phase II Nexus Assessment used the Panta Rhei model and drew on data from 41 hydrological stations and 70 meteorological stations for calibration and validation⁹⁰. This shows that substantial data exist across the basin, but also that they are fragmented and not yet managed as one operational transboundary monitoring system. The GEF Drin Project identified the development of the TDA and the Strategic Action Programme as key steps towards coordinated action on water quality deterioration, hydrological regime variability, biodiversity degradation and sediment transport.

9.7 Monitoring in Albania: way forward

9.7.1 Current Strengths of the Monitoring Network

Despite some limitations in the monitoring framework (financial limitations, staff shortages, logistics and laboratory constraints often reduce actual monitoring intensity below planned levels), the current system offers solid strengths for future development. Key features include multi-year datasets on nutrients, BOD₅, and oxygen parameters, which help track water quality trends and assess pollution risks. Routine physico-chemical monitoring continues across parts of the basin, maintaining consistency for core indicators and supporting regulatory controls. The programme has improved identification of pollution hot-spots, allowing authorities to target resources effectively.

Recent screening for heavy metals has broadened chemical assessments, addressing ecological and health risks beyond organic pollution. Pilot biological surveys show that monitoring Biological Quality Elements is feasible, aligning with WFD standards and reflecting true ecological conditions. Enhanced understanding of pressure pathways highlights cumulative downstream effects, supporting coordinated basin-wide management.

Groundwater monitoring also provides an important foundation for future development. Existing observation wells, abstraction monitoring points, springs used for drinking water supply, and historical hydrogeological datasets offer valuable information on groundwater quantity and quality trends. Although coverage remains uneven, these datasets provide a basis for assessing recharge conditions, groundwater–surface water interactions, and risks associated with abstraction and contamination.

In addition, several elements of protected areas monitoring are already operational through sector-specific programmes. Drinking water sources are subject to sanitary surveillance, bathing waters are monitored seasonally, fisheries management activities are undertaken and biodiversity monitoring is implemented within major protected areas also in the Drin-Buna basin. These activities provide useful institutional experience and datasets that can support the future establishment of an integrated WFD-compliant Protected Areas Monitoring Network.

Overall, the existing system contains valuable data, experience, and methodological advances. With targeted investment in network redesign, biological expansion, chemical updates, and data integration, these foundations can evolve into a robust, WFD-compliant monitoring system for long-term improvement.

⁹⁰ Phase II Nexus Assessment for the Drin River Basin, Global Water Partnership – Mediterranean (GWP-Med), 2022.

9.7.2 Main Gaps in the Current Monitoring System

Despite the progress achieved in recent years, the present monitoring framework for the Drin-Buna River Basin still contains several structural gaps that limit the reliability, completeness, and WFD-compliance of status assessments. These weaknesses affect ecological classification, chemical risk diagnosis, and the ability to design effective management measures, namely:

1. **Limited Biological Monitoring:** Biological Quality Elements (BQEs) like macroinvertebrates, fish, macrophytes, and phytoplankton are monitored infrequently, undermining ecological status assessments under the WFD. Physico-chemical measurements alone cannot capture ecosystem health, meaning rivers may appear healthy by oxygen standards but have degraded biological communities.
2. **Incomplete Chemical Monitoring:** Chemical checks mostly cover basic parameters and some metals, often resulting in "Not assessed" statuses and missing pollution risks. Targeted analyses reveal issues such as cadmium, lead, and nickel contamination, highlighting gaps that hinder EU compliance and pollution management.
3. **Insufficient Hydro morphological Monitoring:** Hydro morphological factors like flow changes, river regulation, channel modifications, sediment disruption, and habitat degradation are rarely assessed, particularly in the Drin-Buna Basin. This leaves significant impacts on ecological status poorly understood.
4. **Weak Data Integration and Information Management:** Data is scattered across platforms without integration of chemistry, biology, hydrology, or spatial information. Lack of unified GIS and QA/QC⁹¹ makes it difficult to track trends, link pressures, compare stations, map basins, support planning, and report under WFD requirements.
5. **Institutional Capacity Constraints:** Technical deficiencies stem from limited staff, expertise, and lab facilities. Shortages in hydrobiologists, taxonomists, environmental chemists, ecotoxicologists, GIS/data specialists, and field staff lead to disrupted monitoring and reliance on individual experts, making institutional improvement as crucial as technical upgrades.
6. **Insufficient Groundwater Monitoring:** Groundwater quantity and quality monitoring remain fragmented and are not yet fully aligned with the requirements of the Groundwater Directive. Observation wells are unevenly distributed, many monitoring points are inactive or sampled intermittently, and automatic groundwater level monitoring is limited. Chemical monitoring focuses mainly on conventional parameters and major ions, while pesticides, hydrocarbons, PFAS, pharmaceuticals, and other emerging contaminants are rarely assessed. The absence of nationally defined groundwater threshold values further constrains robust status classification and trend assessment.
7. **Fragmented Protected Areas Monitoring:** Monitoring of protected areas is implemented through separate sectoral programmes rather than a coordinated WFD framework. Drinking water protected areas, bathing waters, fisheries areas, nutrient-sensitive zones, and nature conservation sites are monitored with varying intensity and methodologies, while some categories, particularly nutrient-sensitive areas, lack dedicated monitoring altogether. The absence of an integrated protected areas register, harmonised datasets, and coordinated ecological monitoring limits assessment of compliance with environmental objectives and reduces the effectiveness of conservation and restoration measures.

9.7.3 Priority Actions for Strengthening the Monitoring System

In analytical terms, the Drin-Buna monitoring network already captures the most important basin pattern: a progressive deterioration from upstream to downstream, intensified by tributary inputs and industrial/agricultural pressures. This is a strong basis for WFD implementation. However, to move from broad diagnosis to a robust WFD-compliant system, the following strategic actions should be prioritised:

1. **Expand Station Coverage and Seasonal Frequency:** The present network should be strengthened through improved spatial representativeness and more regular sampling throughout the hydrological year. Seasonal monitoring is particularly important in the Drin-Buna

⁹¹ Quality Assurance / Quality Control (QA/QC) in water quality monitoring ensures accurate, precise, and reliable data by using documented procedures, staff training, calibration, blanks, duplicates, spikes, and standardized methods. These measures cover sampling, analysis, data management, and equipment maintenance to detect errors and contamination throughout the process.

Basin, where flow variation strongly influences pollutant concentrations and ecological response.

2. Institutionalise Biological Quality Element Monitoring: Routine national programmes should be established for:

- benthic macroinvertebrates;
- benthic diatoms;
- macrophytes;
- phytoplankton;
- fish fauna.

These programmes should replace project-based surveys and become the core of ecological classification.

3. Broaden Priority Substance Screening: Chemical monitoring should progressively cover the full WFD priority substances list, relevant river basin pollutants, and emerging contaminants. Sediment monitoring should also be considered, especially in lower basin accumulation zones.

4. Strengthen Hydro morphological Assessment: A dedicated programme is needed for:

- flow alteration analysis;
- habitat surveys;
- continuity/barrier inventories;
- sediment transport monitoring;
- riparian condition assessment;
- environmental flow evaluation.

This would greatly improve understanding of ecological pressures.

5. Develop Integrated Databases and GIS Tools: A unified digital monitoring platform should combine water chemistry, biology, hydrology, and spatial data. GIS tools are essential for river basin planning, pressure mapping, trend analysis, and efficient reporting.

6. Establish Albanian Ecological Classification Systems: Type-specific ecological classification schemes must be developed in line with WFD principles, including:

- reference conditions;
- class boundaries;
- ecological quality ratios;
- intercalibration approaches.

Without this step, ecological assessments will remain transitional.

7. Estimate Natural Background Levels for Metals: For metals such as cadmium, nickel and lead, assessments should consider natural geochemical background concentrations and bioavailability factors, as foreseen under Directive 2013/39/EU. This is particularly relevant in Albania, where geology may influence baseline concentrations. Without this refinement, there is a risk of overestimating anthropogenic pollution or misclassifying chemical status.

8. Strengthen Groundwater Monitoring Networks: Expand and modernise groundwater quantity and quality monitoring through rehabilitation of observation wells, installation of automatic level loggers and telemetry systems, systematic monitoring of major abstraction points and drinking water sources, and integration of abstraction data with groundwater assessments. Chemical monitoring should be broadened to include pesticides, hydrocarbons, and other emerging contaminants, while national groundwater threshold values should be established in accordance with Groundwater Directive requirements.

9. Establish an Integrated Protected Areas Monitoring Network: Develop a basin-wide WFD Protected Areas Monitoring Network that integrates drinking water protected areas, bathing waters, fisheries areas, nutrient-sensitive zones, and habitat and species protection areas within a common GIS-supported framework.

9.7.4 Strategic Monitoring Development Priorities (2026–2033)

Recent evaluations under the WFD highlight Albania's need for integrated river basin management, focusing on three pillars: chemical integrity, ecological functionality, and hydro morphological structure. The Drin-Buna River Basin is identified as the central case for WFD implementation due to its persistent environmental challenges and multiple pressures.

Albania's main priority is improving chemical status by modernizing monitoring systems, especially in the National Environment Agency's laboratory. Insufficient data and frequent exceedances of WFD priority substances—like cadmium, lead, and nickel—are most acute in the lower Drin-Buna Basin. Upgrading instrumentation, accrediting methods, and ensuring comprehensive monitoring of all priority substances, including sediment contaminants, are critical steps.

Ecological status also needs strengthening. Current assessments rely mainly on physico-chemical indicators, lacking robust Biological Quality Element (BQE) systems. Establishing national ecological classification, surveying reference conditions, and investing in biological expertise and routine BQE monitoring are essential for compliance and accurate degradation detection. Integrating hydro morphological data will improve ecological assessment.

Groundwater protection represents an equally important strategic priority. The Drin-Buna Basin contains heavily used groundwater resources that support public water supply, agriculture, and industry. Future monitoring development should therefore include systematic assessment of groundwater quantity and chemical status, strengthened monitoring of vulnerable aquifers, integration of abstraction and recharge assessments, and establishment of groundwater threshold values consistent with the Groundwater Directive. Particular attention should be given to shallow alluvial aquifers in the lower basin, where pressures from agriculture, industry, and urban development are concentrated.

Protected Areas monitoring must also become a core component of WFD implementation. The basin contains nationally and internationally important protected sites, including drinking water abstractions, Karavasta Lagoon, bathing waters, wetlands, and Natura 2000 candidate conservation areas. Establishing a coordinated monitoring framework for these protected areas will improve compliance with WFD Article 8, strengthen biodiversity conservation, support sustainable fisheries and tourism, and ensure better integration between water management and nature protection objectives.

The lower Drin-Buna corridor presents significant chemical, ecological, and hydro morphological issues and should be prioritized for intervention. Recent data confirm chronic pollution with metals and ongoing organic contamination, resulting in consistently poor ecological status and limited recovery.

Transboundary monitoring should be strengthened and progressively harmonised. Priority should be given to the use of existing stations, updating rating curves, improving hydrological and meteorological data management, integrating hydropower operational data, and establishing agreed protocols for data exchange between Albania, Montenegro, North Macedonia, Greece and Kosovo. The monitoring system should support WFD-compliant assessment of ecological status, hydromorphological alteration, environmental flows, flood and drought risk, sediment transport and the effectiveness of the Programme of Measures. A modern shared web-GIS platform could be used to store, visualise and exchange data among competent authorities and support coordinated implementation of the Drin-Buna RBMP.

To advance WFD implementation, Albania must coordinate chemical, ecological, and hydro morphological restoration within a unified program. The Drin-Buna River Basin, particularly its lower segment, should serve as both a demonstration site and a diagnostic case for national water policy and future river management planning.

10 PRESSURES, STATUS, AND IMPACT ASSESSMENT

This chapter integrates pressure data, monitoring results, and expert judgement to assess the ecological and chemical status of water bodies. It explains the methodology used to link pressures with impacts, following WFD Guidance No. 3 and related EU approaches. The chapter presents basin-wide assessments for surface water, groundwater, and protected areas, identifying at-risk water bodies. It concludes with a discussion of key uncertainties and outlines the next steps toward achieving good status by 2033.

Additional background, technical information, and data are presented in the Task Reports 1, 2, 3, 4a - 4f, 5, 6, 9 and 12.

10.1 Introduction

This chapter presents the assessment of pressures, environmental status, and associated impacts on surface water, groundwater, and protected areas within the Drin-Buna River Basin. The analysis is conducted in line with the EU WFD and applies a DPSIR-based approach to link human activities with ecological and chemical conditions.

The assessment integrates available monitoring data, spatial analysis, and expert judgement to identify key pressure types, evaluate current water body status, and determine the risk of failing to achieve Good Ecological Status or Potential. It provides the analytical basis for prioritising measures within the River Basin Management Plan.

10.2 Overview of Pressures and Impacts in the basin

The Drin-Buna River Basin is subject to a complex and cumulative combination of anthropogenic and climate-related pressures that significantly influence the ecological, chemical, quantitative, and hydro morphological status of surface waters and groundwater. In accordance with the requirements of the EU WFD, the River Basin Management Plan applies the DPSIR (Drivers-Pressures-State-Impact-Response) analytical framework to identify the principal socioeconomic drivers, assess associated pressures, evaluate their impacts on water bodies and aquatic ecosystems, and determine the risk of failing to achieve Good Ecological Status (GES).

The assessment demonstrates that the basin operates under a strongly interconnected multi-pressure regime in which hydrological alteration, pollution, land-use change, hydro morphological degradation, and institutional constraints interact cumulatively across the river system. Pressures rarely occur in isolation. Instead, they reinforce one another spatially and temporally, creating compound ecological effects that exceed the influence of individual stressors alone. Hydropower regulation reduces dilution capacity for pollutants; floodplain disconnection decreases natural nutrient retention; mining and agricultural sediments jointly degrade habitats; and urban wastewater combines with diffuse nutrient loading to intensify eutrophication and oxygen stress in rivers, lakes, transitional waters, and coastal ecosystems.

The most significant basin-wide pressures are associated with:

- hydropower development and flow regulation;
- urban wastewater discharges and storm overflows;
- diffuse agricultural pollution;
- mining, quarrying, and industrial extraction;
- flood protection engineering and channel modification;
- groundwater abstraction and contamination risks;
- solid waste and stormwater runoff;
- climate change and hydrological variability; and

- transboundary governance and institutional coordination challenges.

These pressures affect all major water body categories within the basin, including rivers, lakes, reservoirs, transitional waters, coastal waters, and groundwater bodies. The most heavily impacted areas include the Kaskada e Drinit hydropower system, the Drin–Buna lowland corridor, Lake Shkodër, the Buna River and delta, and mining-affected tributaries of the Drini i Zi sub-basin.

A defining characteristic of the basin is the dominant hydro morphological alteration caused by the Fierza–Koman–Vau i Dejës hydropower cascade and associated infrastructure. Flow regulation, hydropeaking, sediment trapping, and interruption of river continuity fundamentally alter the natural hydrological regime of the Drin system. These pressures reduce ecological flow variability, suppress floodplain inundation, disrupt fish migration pathways, simplify aquatic habitats, and decrease sediment delivery to downstream reaches and coastal systems. The ecological consequences extend throughout the basin, including Lake Shkodër, transitional waters, wetlands, and the Adriatic coastal zone.

Pollution pressures remain equally significant. **Urban wastewater discharges** from major settlements, particularly within the Shkodër–Lezhë corridor, together with insufficient wastewater treatment infrastructure, combined sewer overflows, industrial effluents, and stormwater runoff, generate substantial nutrient, organic matter, suspended solids, microbiological, hydrocarbon, and metal loads. These pressures directly affect physicochemical quality elements and contribute to failures in oxygen balance, eutrophication control, and bathing water quality objectives.

Diffuse agricultural pollution is widespread throughout the lower basin and alluvial plains. Intensive cultivation, fertiliser application, livestock production, irrigation networks, and soil disturbance generate chronic nutrient and sediment loading to rivers, drainage canals, lakes, and lagoons. The resulting eutrophication pressures contribute to algal blooms, oxygen depletion, habitat degradation, and declining ecological resilience in both freshwater and coastal ecosystems.

Mining, quarrying, and aggregate extraction activities further contribute to both chemical and hydro morphological pressures, particularly within the Drini i Zi sub-basin. Historical spoil deposits, active extraction sites, and in-channel gravel removal generate episodic metal contamination and fine sediment transport during storm events. These pressures are often underestimated due to limited event-based monitoring but may cause severe short-term ecological impacts and long-term channel instability.

Flood protection infrastructure and channel engineering have additionally altered the natural dynamics of the lower Drin–Buna system. Embankments, levees, channelization works, and bank stabilisation have reduced lateral connectivity between rivers and floodplains, simplified channel morphology, diminished habitat diversity, and weakened the natural capacity of floodplains to retain nutrients and sediments. These structural pressures compound the impacts of hydropower-induced sediment deficits and reduce the adaptive capacity of downstream ecosystems.

Climate change acts as a cross-cutting pressure that amplifies nearly all existing water management challenges in the basin. Projected increases in temperature, declining summer precipitation, more frequent droughts and floods, reduced runoff, and sea-level rise are expected to intensify hydrological stress, saline intrusion, water scarcity, ecosystem degradation, and coastal vulnerability. Climate change therefore represents both an independent pressure and a multiplier of existing anthropogenic impacts.

The assessment also identifies significant **institutional and technical limitations** affecting basin management. Weak hydrometeorological monitoring systems, fragmented datasets, limited biological and chemical monitoring coverage, insufficient groundwater surveillance, and gaps in hydrological flow measurement create substantial uncertainty in pressure quantification and status assessment. In many cases, risk classification relies partly on expert judgement and precautionary screening logic rather than comprehensive monitoring evidence. Consequently, several water bodies are classified as “Possibly at Risk” pending targeted monitoring and further investigation.

The **transboundary nature of the Drin–Buna Basin further increases management complexity**. Shared water resources with Montenegro, Kosovo, North Macedonia, and Greece require coordinated

planning, harmonised monitoring methodologies, data exchange, and joint management measures. Although regional cooperation mechanisms have improved in recent years, uneven implementation capacity and fragmented institutional coordination continue to constrain fully integrated basin-wide management.

Overall, the pressures and impacts assessment confirms that the Drin–Buna River Basin exhibits widespread ecological vulnerability and a high degree of cumulative environmental stress. Hydrological regulation, nutrient enrichment, sediment imbalance, habitat fragmentation, oxygen depletion, biodiversity decline, and groundwater risks are evident across multiple sub-basins and water body categories. A substantial proportion of assessed water bodies are classified as either “At Risk” or “Possibly at Risk” of failing WFD environmental objectives.

The assessment therefore establishes the principal evidentiary basis for the River Basin Management Plan and the future Programme of Measures. It demonstrates that achieving WFD objectives in the Drin–Buna Basin will require coordinated basin-scale interventions focused on:

- restoration of hydro morphological continuity and ecological flows;
- modernization of wastewater collection and treatment infrastructure;
- reduction of diffuse agricultural pollution;
- groundwater protection and abstraction control;
- strengthened monitoring and data management systems;
- climate adaptation and flood resilience;
- enhanced permitting, enforcement, and institutional coordination; and
- strengthened transboundary cooperation mechanisms.

Without implementation of an integrated, adequately financed, and long-term Programme of Measures, most water bodies within the Drin–Buna River Basin are unlikely to achieve Good Ecological Status or Good Ecological Potential in accordance with the requirements of the WFD.

10.3 Methodology of Pressures and Status Assessment

10.3.1 Introduction

The methodology applied for the identification of pressures, assessment of water status, and screening of risks within the Drin-Buna River Basin is based on the requirements of the EU WFD (WFD 2000/60/EC), the Groundwater Directive (2006/118/EC), associated Common Implementation Strategy (CIS) Guidance Documents, and the Water Information System for Europe (WISE) reporting framework.

The assessment follows the conceptual structure established under:

- WFD Article 5 (River Basin Characterisation and Pressure–Impact Analysis);
- Annex II (Characterisation of River Basin Districts);
- Annex V (Status Assessment and Monitoring), and
- WISE pressure, impact, and status reporting requirements.

The methodology applies an integrated pressure–state–risk approach consistent with the DPSIR framework. Under this concept:

- Drivers represent socioeconomic activities generating pressures;
- Pressures represent direct anthropogenic stressors acting upon water bodies;
- State describes the observed ecological, chemical, quantitative, or hydro morphological condition of waters;
- Impacts represent the resulting effects on aquatic ecosystems, ecological functions, groundwater resources, and water uses; and
- Responses comprise the policy measures and Programme of Measures (PoM) developed to achieve WFD environmental objectives.

The assessment combines:

- pressure inventories;
- WISE-coded pressure identification;

- monitoring information;
- hydro morphological interpretation;
- hydrogeological analysis;
- spatial and GIS-based evaluation;
- risk assessment procedures, and
- expert judgement.

Given the current limitations in monitoring coverage and data completeness within the Drin-Buna River Basin, the methodology applies a precautionary and weight-of-evidence approach consistent with WFD CIS Guidance principles.

10.3.2 Identification and Quantification of Pressures and Indicators

Under the WFD theoretical framework, pressure assessment constitutes the “Pressure” component of the DPSIR analytical chain and forms the basis for identifying water bodies potentially at risk of failing environmental objectives under WFD Article 4.

According to WFD Annex II and CIS Guidance Document No. 3 (Analysis of Pressures and Impacts), Member States are required to identify:

- significant anthropogenic pressures,
- their magnitude and spatial extent,
- the pathways through which pressures affect water bodies, and
- the likely impacts on ecological, chemical, hydro morphological, and quantitative status.

The WISE reporting framework operationalises this requirement through a harmonised pressure typology and coding structure, enabling consistent classification of pressures across European river basin districts. WISE pressure categories distinguish among the following principal categories:

- **Point source pollution**, including discharges from urban wastewater systems, untreated settlements, industrial facilities, mining activities, landfills, and other permitted or non-permitted discharge sources;
- **Diffuse pollution**, primarily associated with agricultural runoff, nutrient enrichment, pesticide use, erosion, sediment transport, and atmospheric deposition;
- **Water abstraction and hydrological alteration**, including surface water abstraction, groundwater abstraction, irrigation withdrawals, hydropower regulation, reservoir operation, and flow modification;
- **Hydro morphological alterations**, including dams, barriers, river regulation, channelization, embankments, sediment interruption, gravel extraction, hydropeaking, bank modification, and habitat fragmentation.
- **Groundwater-specific pressures**, and **Other anthropogenic** or legacy pressures. Climate change was assessed as a cross-cutting pressure multiplier influencing hydrology, flood and drought frequency, water temperature, ecological resilience, sediment transport, and groundwater recharge dynamics.

The pressure analysis considered both current pressures and future risks associated with climate change, socioeconomic development, hydropower expansion, urbanisation, agricultural intensification, and increasing water demand.

The pressure assessment methodology integrates WISE pressure coding, pressure significance screening, source–pathway–receptor analysis, and spatial aggregation techniques to systematically evaluate the interplay between human activities and water body conditions throughout the basin. This approach acknowledges that pressures rarely function independently; instead, ecological, and chemical degradation often arises from the combined effects of multiple stressors, whether acting concurrently or in succession within a single hydrological system. Each pressure's significance is assessed based on magnitude, persistence, spatial distribution, reversibility, connectivity to sensitive receptors, and its capacity to intensify the impact of other pressures. Special attention is devoted to cumulative pressure pathways, where hydrological alterations, pollutant inputs, abstraction pressures, and hydro

morphological changes collectively contribute to increased risks of not meeting WFD environmental standards.

Pressure quantification is therefore undertaken using:

- direct monitoring evidence where available,
- proxy indicators,
- land-use interpretation,
- hydrological and hydrogeological analysis,
- infrastructure inventories,
- abstraction records,
- pollution source inventories, and
- expert interpretation.

Pressure assessment indicators were applied using both:

- qualitative screening approaches; and
- quantitative indicators where reliable datasets existed.

Due to incomplete monitoring systems and fragmented datasets, confidence levels were assigned to pressure assessments in accordance with WFD CIS Guidance principles:

- **High confidence** — strong monitoring and supporting datasets;
- **Medium confidence** — partial monitoring with supporting evidence;
- **Low confidence** — limited monitoring and reliance on expert judgement; and
- **No confidence** — insufficient information available.

This confidence-based approach supports prioritisation of enhanced monitoring and investigative assessments under the Programme of Measures. Where empirical evidence is incomplete, the WFD precautionary principle is applied. Water bodies may therefore be screened as “Possibly at Risk” where a plausible pressure–impact relationship exists despite limited monitoring confirmation.

10.3.3 Methodology of Pressures and Status Assessment for Surface waterbodies

The status assessment constitutes the “State” element of the DPSIR (Drivers–Pressures–State–Impact–Response) framework and serves as the primary analytical process for determining the condition of surface water and groundwater bodies within the River Basin Management Plan (RBMP). This approach adheres to the requirements set forth by the EU WFD Annex V, related Common Implementation Strategy (CIS) Guidance Documents, hydro morphological assessment standards, and the WISE ecological and chemical status reporting requirements.

Under the WFD, surface water assessment is based on the principle that aquatic ecosystems should achieve:

- Good Ecological Status (GES), and
- Good Chemical Status (GCS).

For Artificial Water Bodies (AWBs) and Heavily Modified Water Bodies (HMWBs), the objective is:

- Good Ecological Potential (GEP).

The surface water body assessment methodology was developed in accordance with the requirements of the WFD for ecological status assessment, supporting hydro morphological quality element evaluation, and chemical status classification. The methodology applies to all principal surface water categories, including rivers, lakes and reservoirs, transitional waters, and coastal waters, ensuring a consistent and integrated assessment framework across different aquatic environments.

Delineation and typology

Surface water bodies are delineated according to:

- hydrological characteristics;
- catchment structure;
- waterbody type;
- hydro morphological conditions;

- ecological relevance; and
- significant pressure boundaries.

Artificial Water Bodies (AWBs) and Heavily Modified Water Bodies (HMWBs) were identified in accordance with WFD Article 4 and WISE reporting requirements.

Hydropower reservoirs within the Drin cascade were assessed as HMWBs due to substantial hydrological and morphological alteration associated with energy production and flow regulation.

Ecological status assessment

The ecological status assessment follows the theoretical framework established under WFD Annex V, where ecological status is defined as the degree of deviation of aquatic biological communities from reference or near-natural conditions. Under this concept, ecological status represents the integrated response of river, transitional, and coastal ecosystems to the combined influence of pollution pressures, hydrological alteration, hydro morphological modification, and habitat degradation. The assessment therefore interprets ecological condition not as an isolated water-quality measurement, but as the cumulative ecological expression of multiple interacting pressures acting within the river basin system.

In accordance with the WFD ecological classification system, the assessment integrates:

- Biological Quality Elements (BQEs),
- supporting physicochemical quality elements,
- hydro morphological supporting conditions, and
- pressure–impact relationships.

The ecological status assessment was based on the evaluation of Biological Quality Elements (BQEs) required under the WFD, including benthic macroinvertebrates, macrophytes, and Phyto benthos. These biological elements were assessed in conjunction with supporting physicochemical parameters reflecting the overall functioning and ecological condition of aquatic ecosystems.

Supporting parameters included nutrient concentrations, oxygen balance, temperature regime, salinity, suspended solids, and indicators of organic pollution, which were used to evaluate the influence of anthropogenic pressures and to support ecological status classification where biological datasets were limited or incomplete.

Hydro morphological supporting conditions were also considered as part of the ecological status assessment, particularly factors influencing habitat structure and ecosystem functioning. The assessment included evaluation of hydrological continuity, ecological flow alteration, river continuity interruption, channel modification, habitat simplification, and floodplain connectivity, with emphasis on the extent to which hydro morphological pressures may affect biological communities and ecological processes within the assessed water bodies.

Ecological status classification follows the five WFD ecological status classes:

- **High Status:** The water body shows no or only very minor human alterations. It serves as an undisturbed, natural reference condition with pristine biological communities and high-water quality.
- **Good Status:** There are slight deviations from the natural condition, but the ecosystem remains healthy and fully functioning. The European WFD mandates that all water bodies must achieve at least this status.
- **Moderate Status:** The ecosystem is showing moderate signs of stress or pollution, with noticeable deviations from natural conditions. Certain species may be missing or negatively affected.
- **Poor Status:** The water body is significantly impacted by human activities or pollution. Biological communities are heavily altered, and the ecosystem is impaired.
- **Bad Status:** Severe impairment. The natural ecosystem is severely degraded, and key biological quality elements are largely absent or destroyed.

The assessment also applies the WFD “one-out-all-out” principle, whereby deterioration of a single relevant quality element may determine the overall ecological classification of a water body.

The assessment methodology is based on the understanding that ecological degradation frequently results from the cumulative interaction of multiple pressures rather than isolated stressors. Accordingly, the analysis incorporates pressure–response relationships linking pollution loads, abstraction pressures, hydrological alteration, sediment transport disruption, habitat fragmentation, and hydro morphological modification with likely ecological impacts on aquatic biological communities.

However, the assessment remains constrained by the limited development of Albania's biological monitoring systems. Systematic monitoring of BQEs across the basin is not yet fully established, ecological reference conditions remain only partially defined, and long-term biological datasets are fragmented or unavailable for many water bodies. Consequently, direct ecological classification based exclusively on biological monitoring could not be consistently applied throughout the basin.

Where biological monitoring data were absent, incomplete, or insufficiently representative, indicative ecological conditions were inferred through an integrated evaluation of supporting quality elements, documented pressures, and available hydro morphological evidence. In accordance with the precautionary and risk-based principles of the WFD assessment framework, water bodies subject to significant nutrient enrichment, persistent chemical pollution, ecological flow alteration, sediment imbalance, abstraction pressure, or major hydro morphological modification were considered likely to experience ecological impairment even where direct biological confirmation was unavailable.

This approach reflects the provisions of the WFD Common Implementation Strategy (CIS) Guidance, which recognises that, in situations where biological monitoring systems remain incomplete or datasets are spatially or temporally insufficient, ecological status assessment may be supported by:

- supporting physico-chemical and hydro morphological quality elements;
- pressure-impact relationships and pressure-based inference;
- expert judgement; and
- precautionary ecological screening.

Accordingly, the assessment applied a weight-of-evidence methodology combining available monitoring results with identified anthropogenic pressures and known ecological responses. This enabled the identification of water bodies potentially failing to achieve Good Ecological Status despite limitations in biological datasets, while ensuring consistency with WFD Article 5 risk assessment principles and Annex V ecological classification requirements.

Hydro morphological assessment

A hydro morphological assessment was undertaken as a supporting component of the ecological status classification in accordance with the requirements of the WFD. The assessment focused on the extent to which hydrological alteration and physical modification influence aquatic habitats, ecological processes, and the condition of biological communities within surface water bodies.

The evaluation considered key hydro morphological parameters including:

- alteration of ecological flows;
- river continuity interruption;
- hydropeaking effects;
- disruption of sediment transport processes;
- channel modification and river engineering;
- floodplain connectivity; and
- changes in habitat structure and morphological diversity.

Close attention was given to the impacts of dams, hydropower operations, abstraction pressures, channelisation, bank reinforcement, gravel extraction, and other hydro morphological pressures capable of altering natural flow regimes and habitat conditions. Where direct hydro morphological monitoring data were limited, the assessment applied pressure-based analysis, spatial interpretation, and expert judgement to identify water bodies potentially affected by significant hydro morphological alteration.

Chemical status assessment

Chemical status assessment was undertaken in accordance with the requirements of the WFD and associated daughter directives, based on compliance with:

- Environmental Quality Standards (EQS),
- priority substances,
- river basin specific pollutants, and
- other hazardous substances identified under WFD daughter directives.

The assessment was carried out based on data series available from related monitoring/ NEA for the period of 2019-2025 and EU4Rivers monitoring campaigns during 2023 and 2025. institutions and Project monitoring for the period 2019-2025. The evaluation covered assessment of physico-chemical parameters, including nutrients and some heavy metals.

Surface water bodies were classified into 5 water quality categories of regulatory compliance:

- **High Status:** No or very minor anthropogenic impacts; meets natural background levels.
- **Good Status:** Meets all European Environmental Quality Standards (EQS).
- **Moderate Status:** Certain chemical concentrations exceed baseline levels but have not triggered widespread ecological collapse.
- **Poor Status:** Chemical pollutants (such as nitrates or pesticides) are consistently failing safety thresholds.
- **Bad Status:** Severe chemical degradation that results in the loss of biological communities.

This assessment was grounded in an integrated pressure–monitoring framework that merged quantitative chemical analyses with spatial and sectoral information on pollutant pressures. Core analytical components included:

- Laboratory monitoring of chemical concentrations in surface waters;
- Identification of pollution hotspots, including industrial areas, mining sites, urban centres, and wastewater discharge zones;
- Evaluation of wastewater treatment performance and discharge loads;
- Screening of industrial, IPPC, and non-IPPC activities with potential hazardous releases;
- Assessment of agricultural pressures, including nutrient and pesticide pathways; and
- Documentation of observed or inferred exceedances where data were available.

Where monitoring datasets were incomplete, spatially limited, or temporally inconsistent, a precautionary source–pathway–receptor approach was applied. Known pollution sources, land-use pressures, and hydrological connectivity were used to identify water bodies potentially at risk of chemical status failure, even where direct exceedance evidence was unavailable. Special consideration was given to legacy mining areas, industrial discharge zones, urban wastewater impacts, and intensive agricultural areas as potential contributors to chemical contamination.

The assessment also recognised significant uncertainties associated with limited laboratory capacity, insufficient monitoring frequency, missing coverage of priority substances and emerging contaminants, and uneven spatial monitoring distribution. Consequently, chemical status classifications for some water bodies remain subject to moderate to high uncertainty, highlighting the need for strengthened monitoring infrastructure, expanded analytical capacity, and improved temporal and spatial monitoring coverage to support future WFD compliance assessments.

10.3.4 Risk Assessment and WFD Objective Screening

Risk assessment was undertaken to evaluate the likelihood of water bodies failing to achieve the environmental objectives established under Article 4 of the WFD. The assessment followed a precautionary, evidence-based approach integrating monitoring results, pressure analysis, hydro morphological conditions, and expert evaluation within the broader River Basin Management Planning framework.

Water bodies are classified into three principal risk categories:

- **Not at Risk**, where available evidence indicated that environmental objectives are likely to be achieved and no significant pressures or impacts were identified;
- **Possibly at Risk**, where pressures were present but monitoring data, status assessments, or pressure quantification remained insufficient to confirm objective failure with adequate confidence; and
- **At Risk**, where significant pressures and documented impacts indicated a high likelihood of failing to achieve good ecological, chemical, quantitative, or hydro morphological conditions.

The assessment integrated the magnitude, spatial extent, and cumulative effects of pressures together with the ecological sensitivity and hydro morphological vulnerability of affected water bodies. Particular consideration was given to exceedances of environmental quality standards, groundwater vulnerability, abstraction pressures, hydrological alteration, ecological flow disruption, and evidence of ecological or chemical deterioration derived from monitoring programmes and trend analysis.

Where monitoring coverage, biological datasets, or pressure quantification remained incomplete, expert judgement and precautionary screening were applied to address uncertainty. In such cases, water bodies were conservatively classified as “Possibly at Risk” pending further monitoring, data refinement, and improved status assessment. This approach ensured that uncertainty did not result in underestimation of environmental risks or omission of potentially significant pressures within the RBMP process.

The methodology was also aligned with the WISE reporting framework, linking pressures and impacts to ecological and chemical status assessment through pressure coding, risk screening, ecological classification, chemical status reporting, and confidence level evaluation.

10.3.5 Methodology of Pressures and Status Assessment for Groundwater bodies

Groundwater assessment is undertaken in accordance with the principles of the WFD and the Groundwater Directive (2006/118/EC), supported by CIS Guidance documents and WISE reporting requirements.

Groundwater body characterisation under Annex II combines:

- pressure identification and classification;
- hydrogeological vulnerability assessment;
- receptor sensitivity analysis; and
- conceptual source–pathway–receptor modelling.

This integrated framework ensures that groundwater bodies are consistently evaluated for both chemical and quantitative risk, even where monitoring data are limited, in line with precautionary principles of the WFD.

10.3.6 Pressure Identification and classification

Table 38 presents the initial groundwater body characterisation in accordance with the logic of the WFD Annex II requirements and WISE reporting structure. It summarises the principal categories of pressures affecting groundwater systems, together with their indicative WISE codes, pressure type classification, dominant drivers, migration pathways, potential receptors, and expected status signals.

The table is based on a source–pathway–receptor conceptual framework and is intended to support the initial screening of groundwater bodies for risk of failing good quantitative or chemical status. It integrates both anthropogenic drivers and hydrogeological transmission mechanisms, thereby linking land-use activities and abstraction patterns to observed or potential impacts on groundwater quality and quantity.

The pressure categories include diffuse pollution, point-source contamination, abstraction pressures, recharge alteration, saline intrusion in coastal systems, and legacy or uncertain pressures. Each category reflects a distinct pathway of impact propagation through the aquifer system and is associated with specific receptor sensitivities, such as drinking water abstractions, springs, baseflow-dependent rivers, wetlands, and coastal aquifers.

The “Status Signal” column provides an indicative interpretation of typical groundwater responses associated with each pressure type, supporting subsequent risk screening, vulnerability assessment, and prioritisation of monitoring and management measures within the River Basin Management Planning process.

Table 38 - Initial Characterisation – Pressure Identification.

WISE Pressure Group	Codes (Indicative)	Pressure Type	Key Drivers	Pathways	Potential Receptors	Status Signal (Indicative)
Diffuse pollution pressures	2.1, 2.2, 2.5, 2.6	Chemical	Agriculture, urban runoff, sanitation deficits	Infiltration through soil and vadose zone	Shallow aquifers, wells, springs, baseflow systems	Nitrate increase, pesticide risk, microbial contamination
Point-source pressures	1.1, 1.5, 1.7	Chemical	Wastewater plants, industry, mining, landfills	Direct leakage, infiltration, plume migration	Public supply wells, springs, downstream aquifers	Localised high concentrations, contaminant plumes
Abstraction pressures	3.1, 3.2, 3.3	Quantitative	Irrigation, public supply, industry	Groundwater withdrawal, spring capture	Aquifer storage, springs, connected rivers/wetlands	Declining groundwater levels, reduced discharge
Recharge alteration	6.1, 6.2	Quantitative	Land-use change, sealing, drainage, climate variability	Reduced infiltration, altered recharge distribution	Aquifer recharge zones, connected ecosystems	Reduced recharge rates, seasonal deficits
Saline intrusion (coastal systems)	7.1 (regional adaptation)	Chemical/Quantitative	Over-abstraction, sea level pressure	Hydraulic gradient reversal	Coastal aquifers, wells, wetlands	Increasing chloride, EC rise, seawater intrusion
Legacy/uncertainty in pressures	9.1, 9.2, 9.3	Mixed	Abandoned industry, historical mining	Residual contamination, diffuse migration	Local aquifers, springs, downstream systems	Uncertain plumes, sporadic contamination signals

10.3.7 Groundwater Body Sensitivity (hydrogeological characterisation)

Groundwater vulnerability varies significantly depending on hydrogeological setting. Table 39 presents a hydrogeological vulnerability characterisation of groundwater systems, developed to support the implementation of the WFD Annex II requirements within the groundwater body risk assessment framework. The classification provides a conceptual overview of how different hydrogeological settings influence groundwater susceptibility to chemical and quantitative pressures.

The table links aquifer typology to vulnerability level, key hydrogeological characteristics, dominant contaminant or flow pathways, and the principal controls governing system sensitivity. It is based on a conceptual source–pathway–receptor approach and is used to inform risk screening, pressure interpretation, and prioritisation of monitoring and management actions.

Hydrogeological settings are grouped into lowland alluvial aquifers, coastal aquifers, fractured and karst systems, mining and industrial aquifers, and upland aquifers. Each setting exhibits distinct behaviour in terms of recharge dynamics, attenuation capacity, and interaction with anthropogenic pressures.

Vulnerability levels range from low to very high depending on aquifer structure, depth, permeability, and degree of protection. High-vulnerability systems, such as karst and coastal aquifers, are particularly sensitive to rapid contaminant transport, saline intrusion, and abstraction-induced impacts, whereas upland aquifers generally exhibit lower but locally variable sensitivity linked to seasonal recharge and abstraction conditions.

The “Dominant Pathways” column highlights the principal mechanisms of pressure transmission, including vertical infiltration, drainage network connectivity, conduit flow, plume migration, and lateral seawater intrusion. The “Sensitivity Controls” column identifies the key factors regulating system response, such as hydraulic head balance, recharge variability, source persistence, and abstraction intensity.

This classification supports the interpretation of groundwater risk conditions and provides a basis for integrating hydrogeological understanding into WISE-compliant reporting and River Basin Management Planning processes.

Table 39 - Hydrogeological Setting and Vulnerability Characterisation

Hydrogeological Setting	Vulnerability Level	Key Characteristics	Dominant Pathways	Sensitivity Controls
Lowland aquifers alluvial	High	Shallow groundwater, high permeability, intensive land use	Vertical infiltration, drainage networks	Agricultural loading, abstraction intensity
Coastal aquifers	High	Saline interface, strong human pressure	Lateral seawater intrusion, abstraction cones	Hydraulic head balance, recharge deficit
Fractured/karst aquifers	Very High	Rapid flow, low attenuation capacity	Conduit flow, preferential pathways	Recharge events, spring response sensitivity
Mining/industrial aquifers	High (localized extreme)	Legacy contamination, heterogeneous geology	Plume migration, fracture flow	Source persistence, contaminant mobility
Upland aquifers	Low–Moderate	Higher recharge stability, lower pollution intensity	Local infiltration, spring discharge	Seasonal recharge variability, abstraction points

Receptor Characterisation

The receptor characterisation framework is based on a source–pathway–receptor conceptual model and is aligned with the requirements of the WFD Article 5 and Annex II groundwater body characterisation, as well as WISE reporting logic and the Groundwater Directive risk assessment principles.

Within this framework, pressures are assessed not only at their source, but also in terms of their spatial location, magnitude, and intensity, with particular emphasis on their potential to propagate through hydrogeological pathways and impact sensitive groundwater receptors. This enables a structured evaluation of cause–effect relationships between anthropogenic activities and groundwater system responses.

The receptor-based assessment focuses on interactions between pressures and key groundwater-dependent receptors, including groundwater bodies, public water-supply abstraction points, tapped springs, baseflow-dependent surface waters, and groundwater-dependent ecosystems such as wetlands and riparian habitats. This ensures that vulnerability and risk are assessed in a spatially and functionally explicit manner, reflecting both hydrogeological connectivity and the ecological or socio-economic importance of receptors.

Table 40 presents the receptor characterisation framework applied in the groundwater assessment, consistent with WFD Annex II requirements and WISE reporting practice. It summarises the main receptor types, their dependency on groundwater, sensitivity to pressures, dominant stressors, and their role within the risk assessment process.

Receptors include drinking water abstractions, springs, groundwater-dependent rivers, wetlands, and coastal ecosystems, each exhibiting varying sensitivity depending on hydrogeological dependence, ecological function, and exposure to anthropogenic pressures.

Drinking water abstractions are high-dependency, high-sensitivity receptors, primarily affected by chemical pressures such as nitrate, pesticides, microbiological contamination, and salinity, with direct implications for human health protection. Springs and wetlands are classified as very high-sensitivity receptors due to their rapid response to changes in groundwater quantity and quality, making them key indicators of ecosystem condition and water availability.

Rivers sustained by baseflow act as transitional ecological receptors linking groundwater and surface water systems, where abstraction, recharge variation, and nutrient loading directly influence ecological status. Coastal ecosystems represent highly sensitive transitional systems, where saline intrusion, abstraction pressure, and climate-related stressors may significantly affect both groundwater quality and ecological integrity.

Overall, the receptor classification provides a structured basis for integrating groundwater pressures with ecological and socio-economic impacts, supporting risk evaluation and prioritisation within River Basin Management Planning processes.

Table 40 - Groundwater Receptor Characterisation.

Receptor Type	Dependency	Sensitivity	Main Pressures	Risk Role
Drinking water abstractions	High	High	Nitrate, pesticides, microbiological pollution, salinity	Human health protection
Springs	High	Very High	Abstraction, recharge reduction, contamination pulses	Ecosystem & supply indicator
Rivers (baseflow dependent)	High	High	Abstraction, recharge change, nutrient loading	Ecological status linkage
Wetlands	High	Very High	Groundwater level decline, nutrient enrichment	Biodiversity indicator
Coastal ecosystems	High	Very High	Saline intrusion, abstraction, climate change	Transitional system integrity

Pressures–Receptors Linkage (Risk Screening)

The pressures–receptors linkage framework is structured in accordance with WISE groundwater reporting categories and the conceptual requirements of the WFD Annex II risk assessment approach. It provides a systematic screening tool for evaluating how groundwater pressure categories propagate through hydrogeological pathways and affect sensitive receptors.

Pressures are grouped into five principal categories: point-source pollution, diffuse pollution, abstraction pressures, recharge and hydrological alteration, and legacy or uncertain sources. These represent the main anthropogenic drivers affecting groundwater quantity and quality across the basin.

The linkage analysis identifies affected receptors, including wells, springs, rivers, wetlands, and coastal aquifers, and describes dominant impact mechanisms such as contaminant infiltration, plume migration, reduction of baseflow, depletion of groundwater storage, and saline intrusion.

Risk levels are assigned in indicative terms for comparative screening and prioritisation. Diffuse pollution and recharge alteration are generally associated with medium to high risk due to their spatial extent and system-wide influence. Point-source contamination and abstraction pressures typically present high localised risk due to their direct and rapid impacts on groundwater systems. Saline intrusion in coastal aquifers is classified as high risk given its potential irreversibility, while legacy or uncertain sources are treated as medium to high uncertainty risk due to limited data availability.

Table 41 summarises this groundwater pressure–receptor linkage framework, providing a structured basis for initial risk screening in line with WFD Annex II and WISE reporting requirements. It links each pressure category to the most relevant receptors, the dominant mechanisms of impact, and indicative risk levels based on pressure intensity, receptor sensitivity, and expected impact magnitude and reversibility.

Overall, the framework supports identification of priority pressures, vulnerable receptors, and areas requiring further monitoring, investigation, and management within River Basin Management Planning.

Table 41 - Pressure-receptor linkage.

Pressure Category	Affected Receptors	Likely Impact Mechanism	Risk Level (Typical)
Diffuse pollution	Wells, rivers, wetlands	Gradual contamination via infiltration	Medium–High
Point-source contamination	Local wells, springs	Localised plume formation	High
Abstraction pressures	Springs, rivers, wetlands	Reduced discharge, ecological flow deficit	High
Recharge alteration	All receptors	System-wide storage reduction	Medium–High
Saline intrusion	Coastal wells, aquifers	Irreversible salinisation risk	High
Legacy contamination	Local receptors	Persistent uncertain contamination	Medium–High (uncertain)

Groundwater Status Assessment

Groundwater status assessment is undertaken in accordance with the principles of the WFD and the Groundwater Directive (2006/118/EC), distinguishing between quantitative and chemical status components within a source–pathway–receptor framework.

Quantitative status assessment

Quantitative status is evaluated based on the balance between abstraction and recharge, considering groundwater level behaviour, spring discharge variability, aquifer storage conditions, recharge resilience under climatic variability, and saline intrusion risk in coastal aquifers.

Where monitoring data are limited, a structured screening approach is applied, combining abstraction intensity relative to estimated recharge, hydrogeological vulnerability, receptor dependency, and expert judgement. This ensures that groundwater bodies with limited observation data are still assessed within a precautionary WFD-compliant framework.

Chemical status assessment)

Chemical status is assessed using available hydro - chemical data supported by pressure–pathway analysis, focusing on key indicators including nitrate and ammonium, conductivity and salinity parameters (chlorides and sulphates), pesticides, hydrocarbons, heavy metals, and other locally relevant pollutants.

Classification is based on compliance with environmental quality standards and, where data are insufficient, inferred risk derived from pressure intensity, land-use patterns, and hydrogeological vulnerability.

Typical pressure–impact patterns include diffuse agricultural nitrate contamination in lowland aquifers, wastewater-related pollution in peri-urban areas, mining-related metal contamination in selected sub-basins, and saline intrusion in coastal aquifers linked to abstraction stress.

Confidence Assessment

Confidence in groundwater status classification is assigned in accordance with WISE guidance using a four-level scale:

- 0 = no information
- 1 = low confidence
- 2 = medium confidence
- 3 = high confidence

Many groundwater bodies currently fall within low to medium confidence categories due to limited monitoring density, insufficient temporal datasets, incomplete chemical parameter coverage, and lack of systematic abstraction metering.

Strengthening of groundwater monitoring networks, hydro - chemical analysis capacity, and long-term surveillance systems is therefore essential to improve the robustness of future River Basin Management Plan (RBMP) cycles.

Risk Outcome (Interpretation)

Groundwater bodies are screened for risk of failing to achieve good chemical or quantitative status in accordance with the WFD Annex II characterisation framework. The assessment integrates key determinants including abstraction pressure, contamination vulnerability, recharge conditions, land-use intensity, ecosystem dependency, hydrogeological sensitivity, and available monitoring evidence.

Given limitations in monitoring coverage and data completeness, a precautionary approach is applied where uncertainty affects confidence in classification outcomes. The resulting classification provides a simplified but consistent basis for categorising groundwater bodies according to their likelihood of failing WFD environmental objectives.

Groundwater bodies are classified into three principal risk categories:

Groundwater Body Condition	Interpretation
At Risk	Significant pressures present with confirmed or highly probable impacts on chemical or quantitative status
Possibly at Risk	Pressures identified, but monitoring evidence is insufficient or uncertain to confirm status deterioration
Not at Risk	Low pressure conditions with no evidence of significant impact

This classification supports harmonised RBMP reporting, enables comparability across groundwater bodies, and provides a basis for prioritising monitoring, investigation, and management measures.

10.3.8 Methodology of Pressures and Status Assessment for Protected Areas

The methodology for protected areas assessment is derived from the requirements of the WFD, particularly Article 6 and Annex IV, and is aligned with related EU environmental acquis, including the Habitats and Birds Directives, bathing water protection provisions, groundwater protection obligations, and WISE protected area reporting procedures (*see Task Report 4a – 4f and 5*).

Within the WFD framework, protected areas are defined as water-dependent ecosystems or water uses requiring enhanced protection due to their ecological sensitivity, biodiversity importance, public health relevance, drinking water abstraction function, or broader socio-economic value. Accordingly, the assessment integrates ecological condition, hydrological integrity, water quality status, vulnerability, and pressure analysis into a unified analytical framework.

The methodological approach follows a pressure–state–vulnerability–risk logic consistent with River Basin Management Planning principles, combining monitoring evidence, spatial analysis, and expert judgement to address variability and gaps in available data.

Assessment Framework

The assessment is structured around two interlinked dimensions:

- 1) *Status of water-dependent ecosystems:*
 - a) Ecological condition (habitat quality and biodiversity integrity);
 - b) Physic-chemical status (nutrients, pollutants, salinity indicators); and
 - c) Hydrological integrity (flow regime, groundwater levels, and connectivity).
- 2) *Pressure analysis affecting protection objectives:*
 - a) Identification and characterisation of anthropogenic pressures;
 - b) Spatial overlap between pressures and protected area boundaries; and
 - c) Intensity, persistence, and cumulative effects of stressors.

This dual structure enables differentiation between formal designation and actual environmental performance, particularly relevant in contexts where protection frameworks exist but implementation and enforcement remain uneven.

Pressure–Impact Analysis

Protected areas were assessed through key WFD-relevant pressure categories in order to identify and characterise the main stressors affecting their environmental objectives. The analysis considered nutrient enrichment arising from agricultural activities and wastewater discharges.

Hydro morphological pressures were also a central component of the assessment, including alterations driven by hydropower regulation, river engineering, and infrastructure development, which may affect flow regimes, habitat structure, and ecological continuity. These were complemented by pressures related to habitat fragmentation and the resulting loss of ecological connectivity across aquatic and riparian systems.

In coastal and lowland groundwater systems, the assessment accounted for saline intrusion processes, while seasonal tourism activities were considered as additional sources of localised pressure. Abstraction impacts on groundwater bodies and spring systems were also evaluated, particularly where they influence ecological flow conditions and ecosystem dependency.

Further attention was given to sediment transport disruption affecting deltaic and lacustrine environments, as well as broader climate-related stressors, including increased drought frequency and temperature-driven ecosystem shifts, which function as amplifying pressures on water-dependent ecosystems.

Ecological Vulnerability

Ecological vulnerability is assessed using a receptor-based approach that focuses on the sensitivity of ecosystems and their capacity to absorb and recover from pressures. The analysis evaluates intrinsic ecological sensitivity and resilience, together with the degree of habitat connectivity and the integrity of ecological corridors that support species movement and ecosystem functioning.

It also considers the biodiversity value of the system, including internationally and nationally designated sites such as Ramsar wetlands and Emerald Network areas, as well as the level of dependence on surface water–groundwater interactions that sustain ecological processes. Exposure to diffuse and point-source pollution is assessed as a key determinant of vulnerability, alongside sensitivity to climate variability and extreme events, which may amplify existing environmental stresses and reduce ecosystem adaptive capacity.

The assessment places particular emphasis on high-sensitivity receptors, including migratory fish habitats, wetlands, bathing water, coastal ecosystems affected by eutrophication and salinity gradient, and drinking water abstraction zones dependent on stable recharge conditions.

Monitoring Constraints and Uncertainty

The assessment is constrained by a range of limitations related to monitoring coverage and institutional integration, which affect the completeness and certainty of the results. These include incomplete spatial and temporal ecological monitoring networks, as well as limited availability of Biological Quality Element datasets, which reduce the ability to fully characterise ecological status trends across water-dependent ecosystems.

Additional constraints arise from fragmented groundwater and spring monitoring systems, which limit the understanding of surface water–groundwater interactions and system-wide hydrological responses. Weak inter-institutional coordination further reduces data integration across water management, environmental protection, and spatial planning authorities.

In addition, incomplete integration of protected area registers with spatial planning and water management systems limits the ability to fully align environmental objectives with territorial development and conservation measures. As a result, the assessment necessarily combines available empirical evidence with expert judgement, applying a precautionary approach where data gaps or uncertainties are significant.

10.4 Surface Waterbody Pressures and Status Assessment

The assessment of surface waterbody pressures and status within the Drin-Buna River Basin constitutes one of the core analytical components of the River Basin Management Plan (RBMP) and provides the technical basis for implementation of the EU WFD. The assessment applies the WFD Annex II pressure–impact framework, linking significant anthropogenic activities and hydro morphological alterations to their likely impacts on rivers, reservoirs, transitional waters, lagoons, and coastal waters in order to support the identification of water bodies at risk of failing environmental objectives.

The assessment confirms that the Drin-Buna River Basin is exposed to a highly interconnected and cumulative pressure regime dominated by hydropower regulation, hydro morphological alteration, industrial and oil-sector pollution, urban wastewater discharges, diffuse agricultural pollution, gravel extraction, abstraction pressures, channel modification, and climate-related hydrological variability. These pressures affect surface waters throughout the basin and frequently interact synergistically, amplifying ecological degradation beyond the effects of individual stressors alone.

Due to the strong upstream–downstream connectivity of the Drin-Buna system, pressures originating in mountainous and regulated river reaches are progressively transferred downstream through hydrological alteration, sediment transport processes, and pollutant mobilisation pathways toward Lake Shkodër, the Buna River corridor, transitional waters, and the Adriatic coastal zone. The basin therefore functions as an interconnected river–lake–wetland–delta continuum in which hydrological alteration, sediment imbalance, nutrient enrichment, and contaminant transport are cumulatively expressed at downstream receptors.

The assessment demonstrates strong spatial differentiation of pressures across the basin. Mining-related sediment mobilisation and contamination pressures are particularly significant within the Drini i Zi sub-basin, while hydrological and hydro morphological alteration associated with the Drini cascade hydropower system represents the dominant pressure affecting regulated sections of the Drin River continuum.

In the lower basin, urban wastewater discharges, diffuse agricultural pollution, floodplain modification, and hydro morphological degradation constitute the principal pressures affecting the Drin–Buna corridor, Lake Shkodër, lowland drainage systems, transitional waters, and coastal ecosystems. The cumulative downstream propagation of hydrological alteration, sediment deficits, nutrient enrichment, and pollution pressures highlights the strong interconnectivity of basin processes and the transboundary nature of environmental risks within the Drin–Buna River Basin.

Overall, the widespread occurrence of urban wastewater discharges, hydrological alteration, mining-related pressures, diffuse agricultural pollution, and hydro morphological modification indicates that a substantial proportion of surface waterbodies within the basin are at risk of failing WFD environmental objectives. On a basin-wide pressure-based assessment, the prevailing pressure regime is considered incompatible with the achievement of Good ecological status or Good ecological potential without the implementation of coordinated basin-scale management measures, strengthened monitoring systems, improved regulatory enforcement, and targeted pressure reduction interventions.

The pressure assessment distinguishes between the following principal pressure categories:

- point-source pollution pressures;
- diffuse pollution pressures;
- abstraction and hydrological pressures;
- hydro morphological pressures; and
- climate-related and other cross-cutting pressures.

These pressure categories are assessed through a combination of monitoring information, infrastructure inventories, hydrological and hydro morphological analyses, land-use assessments, permit and abstraction registers, remote sensing interpretation, and expert judgement in accordance with WFD Annex II screening principles.

10.4.1 Point-source pollution pressures

Urban and industrial wastewater discharges represent one of the most significant point-source pressures within the Drin-Buna River Basin. Many settlements still lack wastewater treatment infrastructure, while several existing treatment plants remain only partially operational or experience reduced efficiency during seasonal peak loading conditions. Although the wastewater treatment plants in Shiroka and Velipoja contribute to reducing seasonal pressures associated with tourism, untreated or insufficiently treated wastewater discharges continue to exert substantial pressure on receiving water bodies.

Urban wastewater pressures are particularly significant within the Shkodër–Lezhë urban corridor, downstream reaches of the Drin and Buna rivers, lowland drainage systems, transitional waters, and coastal zones influenced by municipal effluent inputs. Discharges from municipal outfalls and combined sewer overflows contribute elevated organic and nutrient loads, suspended solids, pathogens, and solid waste to river systems and associated floodplains.

Industrial wastewater discharges remain insufficiently monitored and controlled, partly due to gaps in environmental permitting, compliance enforcement, and inspection capacity. Several industrial facilities continue to operate without fully effective wastewater treatment or environmental control measures. Additional localised pressures are associated with aquaculture activities, where insufficient regulation of feed inputs, veterinary substances, and waste management practices—including illegal or informal operations—may contribute to nutrient enrichment, organic loading, and localised oxygen depletion in reservoirs and slow-flowing water bodies.

The most significant industrial pollution pressures originate from mining and quarrying activities, particularly within the Drini i Zi sub-basin and associated tributaries affected by historical extraction activities. Wastewater generated by mining operations commonly undergoes only limited pre-treatment through small sedimentation basins before discharge or infiltration into spoil and inert waste deposits. These processes contribute to leachate formation and facilitate downstream mobilisation of suspended sediments, metals, and associated contaminants during high-flow events.

Due to incomplete inventories of wastewater outfalls, limited coverage of combined sewer overflow (CSO) records, and insufficient georeferenced discharge datasets, uncertainty remains regarding the precise spatial quantification of point-source pollution pressures. Consequently, the assessment relies on an integrated evidence base comprising demographic distribution, wastewater infrastructure coverage, known discharge locations, permit information, environmental monitoring data, and expert judgement.

In lowland hydraulic systems characterised by low flow velocities—such as canals, floodplain depressions, backwaters, and the Lake Shkodër–Buna corridor—pollutants may be temporarily retained within sediments and low-energy depositional environments. These retention processes contribute to delayed remobilisation during high-flow or recession events, extending the temporal footprint of pollution beyond individual discharge episodes and reducing the representativeness of routine monitoring programmes.

Industrial and mining-affected tributaries are particularly sensitive to event-driven mobilisation of contaminated sediments, resulting in increased turbidity, alteration of substrate composition, and downstream transport of metals and associated contaminants. Storm-driven runoff events further contribute to episodic pollutant pulses through mobilisation of hydrocarbons, suspended solids, litter, and accumulated contaminants from urban and industrial surfaces. These short-duration but high-intensity events are frequently under-represented within routine monitoring datasets.

Overall, the widespread occurrence of untreated or insufficiently treated urban wastewater, inadequately controlled industrial discharges, mining-related contamination, and localised aquaculture pressures represents a significant and persistent threat to water quality, ecological status, and aquatic ecosystem integrity throughout the Drin–Buna River Basin.

Table 42 summarises the main categories of point-source pollution pressures considered in the assessment framework, together with corresponding indicators and principal data sources. The framework links anthropogenic driving forces to pollutant pathways and affected receptors across surface and groundwater bodies.

The selected indicators are designed to capture the magnitude, frequency, spatial extent, and environmental significance of each pressure type. They support the identification of water bodies at risk of failing to achieve good ecological or chemical status under the WFD framework. The assessment integrates administrative datasets, monitoring results, infrastructure inventories, permit registers, and field observations to ensure a consistent and evidence-based basin-wide pressure evaluation.

Table 42 - Point Source Pollution Pressures, Indicators and Data Sources.

Point-Source Driving Force	Pressure Category	Key Indicators	Dominant Pathways / Mechanisms	Potential Receptors	Data Sources
Municipal wastewater systems	Urban wastewater discharges, CSOs, WWTP effluents	Population connected; treatment level (primary/secondary/tertiary); discharge volumes; overflow frequency; BOD, COD, TN, TP; permit compliance	Direct discharge; overflow events; river dilution and sediment accumulation	Rivers, canals, transitional waters, coastal zones, groundwater (shallow infiltration zones)	Utility/infrastructure inventories; municipal records; environmental agency datasets; monitoring data
Industrial facilities (IPPC & non-IPPC⁹²)	Industrial effluents	Type/scale of activity; hazardous substances; chemical load; permit exceedances; compliance frequency	Direct effluent discharge; diffuse leakage; accidental releases	Rivers, sediments, groundwater, downstream aquatic ecosystems	Permit registers; compliance reports; environmental agency datasets; inspections
Mining and quarrying operations	Mining drainage and effluents	Acid mine drainage potential; suspended solids; heavy metals; sediment loads; morphological disturbance	Runoff mobilisation; plume transport; sediment-bound contaminant transfer	Rivers, floodplains, downstream aquifers, reservoirs	Mining permits; monitoring reports; field surveys
Landfills and waste disposal sites	Leachate discharge	Leachate generation; ammonium; heavy metals; proximity to water bodies; containment integrity	Infiltration to groundwater; surface runoff; leachate migration	Groundwater, rivers, drainage channels	Landfill registers; municipal data; groundwater monitoring
Urban drainage infrastructure	Stormwater discharges	Outlet density; runoff intensity; hydrocarbon loads; suspended solids; flood frequency	Event-driven runoff; surface wash-off; rapid transport to receiving waters	Rivers, canals, coastal waters	Drainage maps; municipal infrastructure data; monitoring
Fish farming / aquaculture	Nutrient and organic enrichment	Production intensity; feed input; nutrient release; DO depletion;	Direct discharge; water column enrichment; sediment accumulation	Reservoirs, lakes, slow-flow rivers	Permits; monitoring data; field observations

⁹² IPPC facilities are large industrial operations regulated under the EU Integrated Pollution Prevention and Control Directive, focusing on minimizing environmental impact through best available techniques. Non-IPPC facilities are smaller operations that do not fall under this directive and may have different regulatory requirements. The IPPC is a regulatory framework established by the EU to prevent, reduce, and control pollution from large industrial and commercial facilities. It was introduced by the EU Directive 96/61/EC (known as the IPPC Directive) in 1996 and has since evolved into the Industrial Emissions Directive (IED), which consolidates and updates the principles of IPPC.

Point-Source Driving Force	Pressure Category	Key Indicators	Dominant Pathways / Mechanisms	Potential Receptors	Data Sources
		veterinary chemical use			
River engineering & dredging	Hydro morphological disturbance	Sediment disturbance; turbidity; channel modification; dredging frequency	Physical disturbance; sediment resuspension; habitat alteration	Rivers, floodplains, aquatic habitats	Engineering records; hydro morphological surveys
Municipal wastewater systems	Urban wastewater discharges, CSOs, WWTP effluents	Population connected; treatment level (primary/secondary/tertiary); discharge volumes; overflow frequency; BOD, COD, TN, TP; permit compliance	Direct discharge; overflow events; river dilution and sediment accumulation	Rivers, canals, transitional waters, coastal zones, groundwater (shallow infiltration zones)	Utility/infrastructure inventories; municipal records; environmental agency datasets; monitoring data

10.4.2 Diffuse Pollution Pressures

Diffuse pollution from agriculture represents a growing and complex pressure affecting the ecological and chemical status of water bodies throughout the Drin–Buna River Basin. Unlike point-source pollution, diffuse pollution originates from spatially distributed land-use activities and is primarily transported through surface runoff, infiltration, soil erosion, and irrigation return flows. As a result, pollutant pathways are highly variable in space and time and are strongly influenced by rainfall intensity, hydrological connectivity, land management practices, and seasonal agricultural activity, making diffuse pressures more difficult to monitor, quantify, and regulate through conventional permitting mechanisms.

The principal diffuse pollution pressures originate from agricultural cultivation, livestock farming, and associated rural land-use practices, which contribute excessive loads of nitrogen, phosphorus, suspended solids, pathogens, pesticides, herbicides, and other agrochemical residues to both surface water and groundwater systems. Although the intensity of agricultural pressures varies across the basin, the most affected areas include the western lowlands, Zadrima, the Shkodër lowlands, the Lezhë plains, the lower Drin drainage systems, and associated irrigation and drainage canal networks.

Nutrient enrichment associated with fertiliser application, livestock production, manure runoff, soil erosion, and pesticide use contributes to eutrophication, algal proliferation, oxygen depletion, and elevated sediment and nutrient loading in rivers, lakes, wetlands, lagoons, transitional waters, and coastal ecosystems. These impacts are particularly significant in hydraulically connected lowland systems characterised by extensive canal and drainage infrastructure, where pollutants may be efficiently conveyed toward downstream receiving waters.

The absence or degradation of vegetated riparian buffer zones, together with excessive fertiliser application, poor manure storage and handling practices, and uncontrolled runoff from agricultural land, has accelerated nutrient accumulation in both surface waters and shallow groundwater bodies. These pressures contribute to declining water quality, ecological degradation, and increasing vulnerability of aquatic ecosystems to eutrophication and seasonal oxygen depletion.

Diffuse sediment pressures are further intensified by deforestation, land degradation, gravel extraction, and unstable catchment slopes in upstream and mountainous areas. These processes increase erosion rates and sediment mobilisation, contributing to increased turbidity, substrate alteration, and downstream sediment deposition affecting river habitats, reservoirs, wetlands, and coastal systems. Additional diffuse pressures are associated with uncontrolled solid waste disposal and litter accumulation along riverbanks, canals, floodplains, and lakeshores. Plastics, microplastics, organic waste, and associated contaminants are frequently mobilised during storm-driven first-flush events, resulting in rapid transport of accumulated pollutants into rivers, transitional waters, and coastal environments.

The long-term implications of diffuse pollution include degradation of aquatic biodiversity, loss of habitat quality, oxygen depletion, deterioration of groundwater resources, increased drinking water treatment requirements, reduced suitability of water bodies for recreational use, and declining soil productivity in affected agricultural areas.

Overall, diffuse agricultural and land-use pressures represent a widespread and persistent basin-scale challenge requiring integrated catchment management approaches, improved agricultural practices, strengthened monitoring systems, and enhanced control of nutrient and sediment transport pathways throughout the Drin–Buna River Basin.

Table 43 summarises the principal diffuse pollution pressures affecting water bodies within the basin, together with corresponding assessment indicators and key data sources. In contrast to point-source pressures, diffuse pressures originate from spatially distributed land-use activities and management practices, resulting in cumulative, variable, and less directly measurable impacts.

The assessment framework focuses on identifying the intensity, spatial distribution, and transport pathways of nutrients, sediments, pesticides, pathogens, and other diffuse contaminants originating primarily from agricultural activities, livestock farming, rural settlements, irrigation systems, and erosion-prone landscapes. Indicators are designed to capture pollutant mobilisation potential and transfer pathways to both surface water and groundwater systems.

The supporting evidence base integrates land-use analysis, agricultural statistics, hydrological and erosion datasets, GIS-based spatial modelling, monitoring programmes, and field observations, providing an integrated basin-scale assessment of diffuse pollution pressures.

Table 43 - Diffuse pollution pressures, indicators and data sources.

Driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
Agricultural activities and intensive cultivation	Nutrient runoff; pesticide contamination; irrigation return flows	Agricultural land intensity; fertiliser application rates; irrigation density; proximity to vulnerable water bodies	Surface runoff during rainfall events; leaching to shallow groundwater; drainage network conveyance; irrigation return flow mobilisation	Rivers, lakes, wetlands, coastal waters; shallow groundwater	Agricultural statistics; land-use maps; irrigation authority records; environmental monitoring data; field observations
Livestock farming and grazing	Manure runoff; pathogen transport; nutrient loading	Livestock density; proximity to surface waters; drainage connectivity; erosion susceptibility	Direct runoff from grazing areas; manure wash-off; faecal contamination via drainage channels; overland flow during storm events	Rivers, streams, ponds, groundwater (localised); wetlands	Veterinary and agricultural records; municipal data; monitoring programmes; field inspections
Rural settlements and dispersed habitation	Domestic runoff and sanitation-related pollution	Settlement density; sanitation coverage; drainage connectivity; proximity to water bodies	Leakage from septic systems; direct discharge of untreated wastewater; surface runoff from settlements; infiltration to groundwater	Rivers, canals, shallow aquifers, floodplains	Municipal records; sanitation infrastructure inventories; field surveys
Deforestation and land-use change	Soil erosion and sediment mobilisation	Land cover change; erosion susceptibility; slope instability; drainage connectivity	Increased surface runoff; loss of soil retention capacity; slope erosion; sediment transport via tributaries	Rivers, reservoirs, floodplains, coastal waters	Land cover datasets; forestry records; hydrological studies; field observations
Irrigated agricultural systems	Irrigation return flows; nutrient	Irrigation infrastructure density; fertiliser	Return flow discharge to rivers;	Rivers, irrigation canals, groundwater	Irrigation management plans; agricultural

Driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
	and sediment transport	use intensity; drainage network connectivity	mobilisation of nutrients and salts; increased connectivity between fields and drainage canals	(salinisation risk areas)	databases; water quality monitoring data
Erosion-prone catchments and unstable slopes	Sediment delivery and suspended solids	Catchment slope; erosion risk indices; sediment transport pathways	Hillslope erosion; gully formation; sediment delivery during rainfall events; mass wasting in unstable areas	Rivers, reservoirs, wetlands, downstream coastal systems	Geological surveys; hydrological studies; sediment monitoring datasets
Mixed agricultural–rural catchments	Combined nutrient, sediment, and contaminant runoff	Agricultural intensity; land-use mix; proximity to water bodies; erosion susceptibility	Multiple diffuse pathways: runoff, leaching, drainage connectivity, and episodic storm-driven mobilisation	Rivers, lakes, wetlands, transitional and coastal waters	Integrated RBMP assessments; GIS analysis; monitoring programmes; field surveys
Agricultural activities and intensive cultivation	Nutrient runoff; pesticide contamination; irrigation return flows	Agricultural land intensity; fertiliser application rates; irrigation density; proximity to vulnerable water bodies	Surface runoff during rainfall events; leaching to shallow groundwater; drainage network conveyance; irrigation return flow mobilisation	Rivers, lakes, wetlands, coastal waters; shallow groundwater	Agricultural statistics; land-use maps; irrigation authority records; environmental monitoring data; field observations

10.4.3 Abstraction and hydrological pressures

Surface water quantity within the Drin-Buna River Basin is subject to increasing pressure arising from water abstraction, hydropower regulation, reservoir operation, and weaknesses in water allocation and permitting systems. One of the most significant challenges is the widespread occurrence of unregulated or illegal abstractions, particularly within the agricultural and municipal sectors, resulting from incomplete formalisation of water users, insufficient permitting procedures, and limited enforcement capacity.

Official water-use records indicate a strong dominance of hydropower, accounting for approximately 68% of permitted water use within the basin, reflecting Albania's high dependence on hydropower generation. Other formally permitted uses include industrial abstraction (approximately 6%), well drilling activities (4%), and public water supply (2%), while sanitary uses, inert material extraction, recreation, bottled water production, and aquaculture individually represent relatively small proportions of registered abstractions.

However, the officially recorded abstraction structure underestimates the significance of agricultural water use due to incomplete abstraction registration and limited permitting of irrigation withdrawals. In practice, irrigation abstraction exerts substantial seasonal pressure on rivers, reservoirs, canals, and groundwater bodies, particularly within the western lowlands and intensively cultivated agricultural areas.

Additional quantitative pressures are associated with the operation of reservoirs and hydropower infrastructure. Reservoir storage and release regimes are managed to satisfy multiple and frequently competing objectives, including hydropower production, public water supply, irrigation demand, and flood protection. Inadequate coordination among responsible institutions, together with insufficiently formalised allocation mechanisms, may contribute to unbalanced reservoir releases, inefficient water management, and increased ecological flow stress during low-flow periods.

Significant water losses within municipal water supply systems further intensify pressure on available water resources. In many supply networks, physical losses associated with ageing infrastructure, poor maintenance, and operational inefficiencies remain extremely high, in some cases reaching

approximately 60% of supplied water. These losses represent a major avoidable pressure on both surface water and groundwater resources.

Hydrological alteration associated with the Fierza–Koman–Vau i Dejës hydropower cascade represents one of the dominant basin-scale pressures affecting the Drin River system. The cascade fundamentally modifies the natural hydrological regime through:

- flow regulation;
- hydropeaking;
- sediment trapping;
- interruption of longitudinal continuity; and
- alteration of seasonal hydrological variability.

The principal hydrological and hydro morphological impacts include:

- regulation and re-timing of natural flood pulses;
- intra-daily flow fluctuations associated with hydropeaking operations;
- attenuation of ecological flow conditions;
- interruption of sediment continuity;
- substrate armouring and channel incision downstream of reservoirs;
- reduction of side-channel activity and floodplain inundation; and
- downstream sediment starvation affecting the Buna corridor and delta.

The hydropower cascade has transformed extensive sections of the Drin River from a naturally dynamic sediment-transport system into a highly regulated hydro morphological corridor. Reservoirs function as major sediment sinks, trapping bedload and substantial proportions of suspended sediments, while downstream reaches exhibit simplified channel morphology, coarsened substrates, reduced habitat heterogeneity, and diminished ecological resilience.

These impacts propagate throughout the river continuum, affecting the lower Drin, Lake Shkodër, the Buna River, associated wetlands, transitional waters, and coastal systems. Reduced sediment delivery contributes to shoreline instability, increased coastal erosion susceptibility, and degradation of deltaic and floodplain habitats.

In addition to hydropower regulation, basin hydrology is influenced by multiple abstraction pressures, including:

- irrigation withdrawals;
- public water supply abstractions;
- groundwater pumping;
- localised hydropower diversions; and
- seasonal tourism-related water demand in coastal areas.

Groundwater abstraction additionally affects hydraulic connectivity between aquifers, springs, wetlands, and connected river systems, contributing locally to groundwater level decline and reduced baseflow contributions to rivers during dry periods.

Despite the significance of these pressures, the abstraction register remains incomplete, particularly regarding operational irrigation withdrawals, private abstractions, and seasonally variable water use. These data limitations introduce uncertainty into quantitative water balance assessments and constrain the reliability of basin-scale evaluation of hydrological pressures and ecological flow conditions.

Overall, the combined effects of hydropower regulation, abstraction pressures, infrastructure inefficiencies, and incomplete abstraction control represent a major constraint on the achievement of sustainable water resource management and Good ecological status within the Drin–Buna River Basin.

Table 44 summarises the principal hydrological and abstraction pressures affecting the basin, together with corresponding indicators and data sources. These pressures primarily influence the quantitative status and hydro morphological condition of water bodies through flow alteration, abstraction-induced depletion, reservoir regulation, and disruption of natural hydrological regimes.

The assessment focuses on evaluating the magnitude and spatial extent of flow modifications caused by hydropower operations, irrigation systems, public water supply abstractions, groundwater extraction, and river regulation schemes. Indicators capture changes in ecological flows, seasonal hydrological variability, groundwater levels, and flow continuity. The analysis integrates abstraction registers, hydrological monitoring data, reservoir operation records, hydrogeological studies, and field observations to support a basin-scale assessment of water quantity pressures.

Table 44 - Hydrological and abstraction pressures, indicators and data sources.

Hydrological driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
Hydropower infrastructure and dam regulation	Reservoir operation; flow regulation; hydropowering; ecological flow alteration	Share of regulated/diverted flow; ecological flow deficit; intra-daily flow variability; seasonal flow alteration; continuity disruption	Flow regulation and hydropowering; interruption of natural flow regime; attenuation and re-timing of flood pulses; sediment retention altering downstream hydraulics	Main river channels (Drin system); tributaries; Lake Shkodër; Buna River; wetlands; coastal and deltaic systems	Hydropower infrastructure inventories; reservoir operation records; hydrological monitoring; ecological flow assessments; field observations
Public water supply abstractions	Surface and groundwater abstraction for municipal supply	Abstraction volumes; depleted river reach length; ecological flow deficits	Direct abstraction from surface/groundwater; reduction of baseflow contributions; localised river reach dewatering	Rivers; groundwater bodies; dependent ecosystems; downstream users	Abstraction registers; utility operational data; groundwater monitoring; river gauging stations
Irrigation systems and agricultural withdrawals	Irrigation abstraction from surface and groundwater	Abstraction volumes; seasonal diversion rates; alteration of flow regimes	Seasonal surface water withdrawals; groundwater pumping for irrigation; diversion through canals reducing river discharge	Rivers; irrigation canals; groundwater aquifers; agricultural lowlands	Irrigation authority records; permits; agricultural water use statistics; hydrological datasets
Groundwater extraction	Groundwater abstraction for agriculture, industry, and domestic use	Groundwater abstraction volumes; groundwater level trends; surface-groundwater interaction impacts	Aquifer depletion; reduced baseflow to rivers; altered hydraulic gradients; potential streamflow loss	Groundwater bodies; springs; rivers (baseflow-dependent reaches); wetlands	Groundwater registers; piezometric monitoring; hydrogeological studies; NEA datasets
River diversion and channel regulation schemes	Flow diversion and regulated discharge operations	Depleted reach length; flow disruption intensity; diversion ratios	Artificial flow routing; channel bypassing; interruption of longitudinal connectivity; altered discharge distribution	River corridors; floodplains; wetlands; downstream receiving waters	River basin management records; engineering inventories; hydrological surveys
Multi-purpose reservoir management	Storage-driven flow regulation	Seasonal flow alteration; reservoir regulation index; storage-release dynamics	Storage buffering and controlled release; modification of seasonal hydrograph; dampening of natural variability	Entire regulated river system; downstream floodplains; transitional and coastal waters	Reservoir management plans; hydrological models; operational records
Hydropower infrastructure and dam regulation	Reservoir operation; flow regulation; hydropowering; ecological flow alteration	Share of regulated/diverted flow; ecological flow deficit; intra-daily flow variability; seasonal flow alteration;	Flow regulation and hydropowering; interruption of natural flow regime; attenuation and re-timing of flood	Main river channels (Drin system); tributaries; Lake Shkodër; Buna River; wetlands; coastal and deltaic systems	Hydropower infrastructure inventories; reservoir operation records; hydrological monitoring; ecological flow

Hydrological driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
		continuity disruption	pulses; sediment retention altering downstream hydraulics		assessments; field observations
Public water supply abstractions	Surface and groundwater abstraction for municipal supply	Abstraction volumes; depleted river reach length; ecological flow deficits	Direct abstraction from surface/groundwater; reduction of baseflow contributions; localised river reach dewatering	Rivers; groundwater bodies; dependent ecosystems; downstream users	Abstraction registers; utility operational data; groundwater monitoring; river gauging stations
Irrigation systems and agricultural withdrawals	Irrigation abstraction from surface and groundwater	Abstraction volumes; seasonal diversion rates; alteration of flow regimes	Seasonal surface water withdrawals; groundwater pumping for irrigation; diversion through canals reducing river discharge	Rivers; irrigation canals; groundwater aquifers; agricultural lowlands	Irrigation authority records; permits; agricultural water use statistics; hydrological datasets

10.4.4 Hydro morphological pressures

The Drin–Buna River Basin is naturally prone to flooding due to its hydrological regime, topographic characteristics, and the strong connectivity between mountainous catchments, lowland floodplains, Lake Shkodër, and the Buna River corridor. In recent decades, both the frequency and intensity of flood events have increased, influenced by a combination of climate-related hydrological variability, extreme precipitation events, land-use change, and river regulation practices associated with hydropower development.

Hydropower infrastructure along the Drin River represents one of the dominant hydro morphological pressures affecting basin hydrology and flood dynamics. Severe flooding events, including the major flood event of 2010, were exacerbated by emergency reservoir releases from the Fierza, Koman, and Vau i Dejës hydropower plants, resulting in the inundation of more than 10,000 hectares and affecting over 2,000 households within the Shkodër region downstream.

The Drin River currently contains three major operational hydropower plants—Vau i Dejës, Koman, and Fierza—with a combined installed capacity of approximately 1,350 MW. Additional hydropower development pressures include the planned Skavica hydropower project upstream and the operational Ashta hydropower plant downstream, with an installed capacity of approximately 48.2 MW.

Hydropower expansion pressures within the basin extend beyond the main cascade system. According to information provided by the National Agency of Natural Resources (NANR), by early 2018 approximately 29 small hydropower plants (SHPPs) were operational within the basin, while concession agreements had been approved for the construction of approximately 121 SHPPs with an estimated installed capacity of around 650 MW. Additional facilities were reported to be operating without fully formalised concession arrangements. The cumulative effect of existing and planned hydropower infrastructure therefore represents a major long-term pressure on river continuity, sediment transport, ecological flow conditions, and aquatic habitat integrity throughout the basin.

Hydro morphological pressures are widespread across the Drin–Buna River Basin and include:

- dams and reservoirs;
- channelisation;
- flood embankments and levees;
- bank reinforcement;
- gravel extraction;
- river training works;
- flood protection infrastructure; and
- alterations of natural sediment transport processes.

These pressures fundamentally modify river morphology, hydrological connectivity, sediment dynamics, and floodplain interaction processes. The resulting impacts include reduced habitat diversity, interruption of fish migration pathways, simplification of channel structure, altered substrate composition, and declining resilience of aquatic ecosystems.

Hydrological regulation and physical confinement of river corridors additionally reduce the lateral connectivity between rivers and adjacent floodplains. This diminishes the natural retention and attenuation capacity of wetlands and floodplain systems, including their functions related to sediment deposition, nutrient retention, denitrification, organic matter processing, and hydraulic buffering during flood events.

Therefore, downstream transport of nutrients, fine sediments, suspended solids, and organic matter is intensified, increasing cumulative pressures on Lake Shkodër, the Buna River corridor, transitional waters, and coastal ecosystems.

The most significant hydro morphological alterations within the basin are associated with:

- the Drin hydropower cascade;
- the lower Drin–Buna floodplain system;
- regulated and channelised river corridors;
- mining-affected tributaries; and
- coastal and deltaic systems affected by sediment deficits and shoreline instability.

In downstream and coastal environments, reduced sediment delivery caused by reservoir trapping and river regulation contributes to channel incision, coastal erosion, shoreline instability, and degradation of deltaic habitats. These processes are further amplified by sea-level rise, altered hydrodynamics, and increasing climate-related hydrological variability.

Overall, hydro morphological alteration represents one of the most pervasive and structurally significant pressures affecting the ecological functioning of the Drin–Buna River Basin, with impacts extending across the entire river continuum from upstream regulated reaches to downstream floodplain, transitional, and coastal systems.

Table 45 summarises the principal hydro morphological pressures in the basin, together with the corresponding indicators and key data sources used in the assessment. Hydro morphological pressures affect the physical structure, continuity, flow dynamics, and habitat conditions of river systems and are strongly linked to ecological status degradation under the WFD.

The assessment evaluates the extent and intensity of river regulation, channel modification, sediment regime alteration, floodplain disconnection, and habitat simplification resulting from hydropower development, flood protection infrastructure, river engineering works, gravel extraction, and urban river modifications. Indicators focus on river continuity interruption, sediment deficit, degree of channel modification, and the spatial extent of regulated river reach.

The analysis integrates GIS-based spatial assessment, hydro morphological field surveys, satellite imagery interpretation, infrastructure inventories, hydrological studies, and field verification, providing a consistent basin-scale evaluation of hydro morphological alteration.

Table 45 - Hydro morphological pressures, indicators, and data sources – Drin-Buna River Basin.

Driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
Hydropower dams and reservoirs	Dams, reservoirs, sediment interruption	River continuity interruption; sediment deficit; extent of regulated river reaches; flow regulation intensity	Flow regulation and hydropowering; sediment trapping in reservoirs; interruption of sediment continuity; alteration of flood	River channels (mainstem and tributaries); floodplains; Lake Shkodër; Buna River; coastal and deltaic systems	Hydropower concession data; infrastructure inventories; GIS analysis; continuity assessments; field verification

Driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
			pulses and seasonal regimes		
Flood protection infrastructure	Embankments, levees, flood control structures	Floodplain disconnection; degree of channel confinement/modification	Physical separation of river–floodplain systems; reduction of lateral connectivity; restriction of natural inundation dynamics	Floodplains; wetlands; riparian zones; lowland agricultural corridors	Infrastructure inventories; satellite imagery; GIS analysis; field observations
River engineering and channel modification	Channelisation, river training, bank reinforcement	Channel modification intensity; habitat simplification; regulated reach extent	Channel straightening and confinement; bank stabilisation; alteration of hydraulic geometry; loss of morphological diversity	River corridors; riparian habitats; aquatic ecosystems in regulated reaches	GIS analysis; satellite imagery; engineering records; field surveys
Gravel extraction and dredging	In-channel extraction activities	Sediment deficit; channel incision risk; morphological disturbance	Direct removal of bed material; disruption of sediment transport balance; increased erosion and channel instability	Riverbeds; downstream reaches; floodplains; estuarine/coastal systems	Field surveys; hydro morphological assessments; permits; satellite imagery
Sediment regime alteration (system-wide)	Sediment transport disruption	Basin-scale sediment deficit; continuity of sediment transport	Integrated effects of dams, channelisation, and extraction leading to reduced sediment supply and altered transport dynamics	River systems; Lake Shkodër; Buna delta; coastal and marine systems	Hydrological and sediment studies; GIS analysis; modelling outputs
Urban river modifications	Artificial bank structures and confined channels	Habitat simplification; channel alteration degree	Channel lining and bank reinforcement; encroachment of urban infrastructure; reduction of natural river dynamics	Urban river sections; downstream floodplains; receiving waters	Municipal infrastructure inventories; satellite imagery; field observations
Regulated river reaches and water transfer systems	Flow regulation infrastructure	Extent of regulated reaches; continuity disruption	Diversion structures and controlled releases; altered flow routing; interruption of longitudinal connectivity	Mainstem rivers; tributary systems; downstream wetlands and transitional waters	Hydropower operation data; GIS analysis; river basin datasets
Driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
Hydropower dams and reservoirs	Dams, reservoirs, sediment interruption	River continuity interruption; sediment deficit; extent of regulated river reaches; flow regulation intensity	Flow regulation and hydropowering; sediment trapping in reservoirs; interruption of sediment continuity; alteration of flood pulses and seasonal regimes	River channels (mainstem and tributaries); floodplains; Lake Shkodër; Buna River; coastal and deltaic systems	Hydropower concession data; infrastructure inventories; GIS analysis; continuity assessments; field verification

Driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
Flood protection infrastructure	Embankments, levees, flood control structures	Floodplain disconnection; degree of channel confinement/modification	Physical separation of river–floodplain systems; reduction of lateral connectivity; restriction of natural inundation dynamics	Floodplains; wetlands; riparian zones; lowland agricultural corridors	Infrastructure inventories; satellite imagery; GIS analysis; field observations

10.4.5 Climate-related and other cross-cutting pressures

Climate change acts as a cross-cutting pressure amplifier throughout the basin. Projected increases in air temperature, declining summer runoff, more frequent droughts and floods, sea-level rise, and increasing hydrological variability are expected to intensify:

- saline intrusion;
- water scarcity;
- ecosystem degradation;
- flood risk;
- sediment instability; and
- coastal erosion.

At the sub-basin scale, the assessment also identifies institutional and technical pressures that further exacerbate vulnerability, including:

- fragmented governance structures;
- weak enforcement capacity;
- insufficient hydrometeorological and ecological monitoring networks;
- limited biological assessment capacity;
- inadequate and discontinuous hydrological datasets; and
- incomplete transboundary coordination mechanisms.

Transitional and coastal waters function as cumulative receiving environments for upstream pressures conveyed through the Drin–Buna system, including nutrients, suspended solids, hydrocarbons, litter, floatable waste, and diffuse agricultural contaminants, particularly during high-flow and flood events. Reduced sediment delivery from the Drin hydropower cascade, combined with channel confinement, coastal erosion processes, sea-level rise, and altered hydrodynamics, contributes to increasing morpho dynamic instability in the Buna delta and adjacent coastal systems. Transitional and coastal waters therefore represent key downstream receptors of basin-wide hydrological, sedimentological, and pollution pressures.

Table 46 summarises the principal climate-related pressures considered in the basin assessment, together with corresponding indicators and key data sources. Climate change is treated as a cross-cutting driver that amplifies hydrological, ecological, quantitative, and coastal pressures across the basin rather than as an isolated pressure category.

The assessment focuses on evaluating the impacts of rising temperatures, altered precipitation regimes, increased frequency and severity of droughts and floods, hydrological variability, sea-level rise, saline intrusion, and coastal erosion vulnerability. These pressures directly affect water availability, ecological flows, groundwater recharge, river hydrology, and the resilience of aquatic ecosystems and water infrastructure.

The selected indicators are designed to identify long-term climate-related trends and system vulnerabilities. The assessment integrates climate projections, hydrometeorological datasets, hydrological monitoring records, river basin modelling outputs, flood and drought risk assessments, hydrogeological studies, and environmental monitoring programmes to provide an integrated evaluation of climate-related risks within the basin.

Table 46 - Climate-related pressures, indicators and data sources

Climate-related driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
Rising air temperatures and changing climate patterns	Temperature increase and hydrological variability	Projected temperature increase; hydrological variability indices	Increased evapotranspiration; reduced soil moisture; altered snowmelt timing; increased thermal stress in aquatic systems	Rivers; lakes; wetlands; groundwater; aquatic ecosystems	Climate projections; meteorological datasets; regional climate models; hydrological monitoring
Altered precipitation regimes and reduced summer runoff	Drought and low-flow conditions	Declining summer runoff; drought frequency; low-flow indicators	Reduced recharge and runoff generation; prolonged dry periods; decreased baseflow contribution	Rivers; groundwater-dependent ecosystems; wetlands; abstraction-dependent systems	Hydrological records; drought assessments; climate scenarios; river flow monitoring
Extreme rainfall events and hydrological instability	Flood risk and variability	Flood frequency; flood magnitude; hydrological variability	Increased surface runoff; flash flooding; peak discharge amplification; reduced infiltration capacity	Floodplains; river corridors; urban areas; coastal zones	Flood risk assessments; hydrometeorological datasets; GIS flood mapping
Sea-level rise and coastal dynamics	Coastal inundation and saline intrusion	Sea-level rise trends; saline intrusion risk; coastal erosion vulnerability	Saltwater intrusion into aquifers; coastal inundation; shoreline retreat; delta destabilisation	Coastal aquifers; estuaries; transitional waters; agricultural lowlands	Coastal monitoring data; hydrogeological studies; satellite imagery; adaptation assessments
Combined climate-hydrology interactions	Intensification of extremes	Drought-flood co-occurrence; hydrological variability indices	Amplification of hydrological extremes; increased inter-annual variability; cascading catchment-scale impacts	Entire river basin system; water supply infrastructure; ecosystems	Integrated climate-risk assessments; basin modelling; monitoring programmes
Climate impacts on water resources management	Water availability and ecological flow stress	Ecological flow deficits; seasonal water availability changes	Reduced water availability for abstraction; increased competition among users; ecological flow stress	Rivers; abstraction systems; groundwater bodies; dependent ecosystems	Water resource assessments; abstraction data; climate adaptation studies
Climate-related driving force	Pressure category	Key indicators	Dominant pathways / mechanisms	Potential receptors	Data sources
Rising air temperatures and changing climate patterns	Temperature increase and hydrological variability	Projected temperature increase; hydrological variability indices	Increased evapotranspiration; reduced soil moisture; altered snowmelt timing; increased thermal stress in aquatic systems	Rivers; lakes; wetlands; groundwater; aquatic ecosystems	Climate projections; meteorological datasets; regional climate models; hydrological monitoring
Altered precipitation regimes and reduced summer runoff	Drought and low-flow conditions	Declining summer runoff; drought frequency; low-flow indicators	Reduced recharge and runoff generation; prolonged dry periods; decreased baseflow contribution	Rivers; groundwater-dependent ecosystems; wetlands; abstraction-dependent systems	Hydrological records; drought assessments; climate scenarios; river flow monitoring

10.4.6 Status Assessment at Subbasin Level

This section identifies the significant anthropogenic pressures and associated impacts affecting surface waters within the Drin-Buna River Basin District, structured according to the officially delineated sub-basins. It provides the analytical basis for the pressure-driven evaluation of ecological status and risk under the EU WFD Annex II methodology.

The assessment follows the WFD DPSIR framework and Annex II screening approach, linking anthropogenic activities and hydrological modifications to their likely ecological effects on river, lake, transitional, and coastal water bodies. It supports the identification of water bodies at risk of failing to achieve environmental objectives.

Where monitoring data are limited or incomplete, risk classification is derived using pressure-based expert judgement consistent with WFD Annex II principles, supported by hydro morphological interpretation, land-use analysis, and known emission pathways.

The pressure coding framework applied throughout the assessment follows the basin-wide classification system and includes:

- Urban wastewater and point sources (1.1)
- Mining and extractive activities (1.4)
- Diffuse agricultural pollution (2.1 / 2.5)
- Urban runoff and stormwater (2.3)
- Hydrological alteration (3.1 / 3.5)
- Sediment continuity disruption and morphological change (3.3)
- Longitudinal continuity interruption (3.4)
- Litter and solid waste (2.10)

Given the strong longitudinal connectivity of the Drin–Buna River–lake–delta continuum, pressures propagate downstream through sediment transport, pollutant mobilisation, and regulated flow regimes, affecting progressively lower basin components including Lake Shkodër, the Buna River, transitional waters, and the Adriatic coastal zone.

10.4.7 Basin Pressure Regime Overview

The Drin-Buna River Basin is characterised by a strongly interconnected multi-pressure system dominated by seven principal drivers:

1. Hydropower regulation and hydrological alteration (3.1 / 3.5)
2. Sediment continuity disruption due to dams and river regulation (3.3)
3. Urban wastewater discharges and insufficient treatment (1.1)
4. Diffuse agricultural pollution from lowland intensification (2.1 / 2.5)
5. Mining and quarrying impacts in upstream catchments (1.4)
6. Floodplain modification and hydro morphological simplification (3.3 / 3.4)

These pressures act cumulatively and synergistically, with upstream interventions propagating downstream effects through altered flow regimes, sediment deficits, nutrient loading, and habitat degradation.

Drini i Zi Sub-basin

The Drini i Zi sub-basin (Black Drin Sub-Basin) is primarily affected by mining and quarrying activities distributed along tributaries and valley corridors. These include active extraction sites, spoil deposits, and historical mining areas.

Dominant pressures

- Mining and quarrying activities (1.4)
- Sediment mobilisation from spoil deposits
- Localised riverbed disturbance and gravel extraction (3.3)

Pressure mechanisms

High-flow and storm events mobilise fine sediments and associated contaminants from disturbed areas. These materials are transported downstream, increasing suspended sediment loads and associated pollutant fluxes.

Environmental impacts

- Increased turbidity and suspended solids
- Burial and smothering of benthic habitats
- Channel instability and morphological simplification
- Episodic mobilisation of metals and legacy contaminants
- Downstream sediment pulses affecting connected systems

Risk classification

Due to the dominance of mining-related sediment and contamination pressures, water bodies in the Drini i Zi sub-basin are classified as At Risk of failing environmental objectives.

Kaskada e Drinit (Drin Cascade) Hydropower System

The Kaskada e Drinit (Drin Cascade) represents the most significant hydro morphological alteration system in the basin, comprising the Fierza, Koman, Vau i Dejës, and Ashta hydropower schemes.

Dominant pressures

- Hydrological alteration (3.1 / 3.5)
- Hydropeaking and flow variability
- Sediment retention in reservoirs (3.3)
- Longitudinal continuity interruption (3.4)

Pressure mechanisms

Hydropower operation modifies natural flow regimes through:

- attenuation and re-timing of flood pulses
- rapid intra-day discharge fluctuations (hydropeaking)
- near-total sediment trapping in reservoirs

Environmental impacts

- Loss of ecological flow conditions
- Reduced floodplain connectivity
- Riverbed incision and substrate armouring
- Severe sediment starvation downstream
- Fragmentation of aquatic habitats and migration pathways

Risk classification

Water bodies within the cascade are classified as High Risk, with many likely to be designated as Heavily Modified Water Bodies requiring Good Ecological Potential (GEP) rather than Good Ecological Status (GES).

Drin–Buna Lowlands and Shkodër–Lezhë Corridor

This sub-basin represents a densely populated and agriculturally intensive lowland system receiving multiple point and diffuse pollution inputs.

Dominant pressures

- Urban wastewater discharges (1.1)
- Stormwater runoff (2.3)
- Diffuse agricultural pollution (2.1 / 2.5)
- Channelisation and floodplain disconnection (3.3)

Pressure mechanisms

Municipal discharges and combined sewer overflows introduce organic matter, nutrients, pathogens, and solid waste. Agricultural runoff contributes fertilisers, pesticides, and sediments.

Environmental impacts

- Eutrophication and algal proliferation
- Altered shoreline dynamics and erosion processes
- Habitat degradation in littoral and deltaic zones
- Reduced sediment delivery to coastal systems

Risk classification

The cumulative pressure regime results in High Risk of failing environmental objectives.

Lake Shkodër and Buna River Corridor

Lake Shkodër and the Buna River form a key integrative lowland system receiving upstream hydrological, sedimentary, and pollution inputs.

Dominant pressures

- Upstream hydropower regulation (3.1 / 3.3)
- Urban wastewater inputs (1.1)
- Diffuse agricultural pollution (2.1 / 2.5)
- Sediment deficit and hydro morphological change

Pressure mechanisms

Long residence times and backwater conditions promote accumulation and delayed release of nutrients and sediments.

- Environmental impacts
- Eutrophication and algal proliferation
- Altered shoreline dynamics and erosion processes
- Habitat degradation in littoral and deltaic zones
- Reduced sediment delivery to coastal systems

Risk classification

Lake Shkodër and the Buna corridor are classified as Highly Vulnerable and At Risk.

Ohrid–Prespa Sub-basin

The Ohrid–Prespa system comprises large transboundary lakes with relatively lower direct pressure intensity but high ecological sensitivity.

Dominant pressures:

- Urban wastewater inputs (1.1)
- Diffuse agricultural runoff (2.1 / 2.5)
- Tourism-related shoreline pressures
- Pressure mechanisms
- Nutrient and sediment inputs accumulate slowly due to long hydraulic residence times.

Environmental impacts

- Gradual eutrophication risk
- Littoral habitat disturbance
- Localised ecological degradation in inflow zones

Risk classification

Water bodies are assessed as Possibly at Risk, particularly in shoreline and inflow areas.

Transitional and Coastal Waters

Transitional and coastal waters represent the terminal receiving system of basin-wide pressures.

Dominant pressures

- Nutrient and sediment export from upstream catchments
- Hydrological alteration (3.1 / 3.3)
- Litter and plastics (2.10)

- Coastal erosion processes

Pressure mechanisms

Flood events transport accumulated sediments, nutrients, and pollutants into estuarine and coastal systems.

Environmental impacts

- Coastal erosion and shoreline instability
- Increased turbidity and sedimentation
- Habitat degradation in lagoons and nearshore zones
- Accumulation of plastics and floatable debris

Risk classification

Transitional and coastal waters are classified as High Risk due to cumulative basin-scale loading.

10.4.8 Status Assessment at Surface Waterbody Level

The chart below presents the proportional distribution of assessed waterbody status classes across the main surface water body categories within the basin, including Natural Water Bodies (NWB), Heavily Modified Water Bodies (HMWB), Artificial/Heavily Modified Water Bodies (AWB/HMWB), and Coastal waters. The classification reflects the outcome of the pressure–impact and status assessment undertaken in accordance with the WFD ecological status framework, using the categories High, Good, Moderate, Poor, and Bad.

The figure provides a comparative overview of ecological condition across different waterbody types and illustrates the extent to which hydro morphological alteration, pollution pressures, and cumulative downstream impacts influence the achievement of environmental objectives. The distribution patterns also highlight the progressive deterioration observed from relatively natural inland systems toward heavily modified and coastal receiving environments.

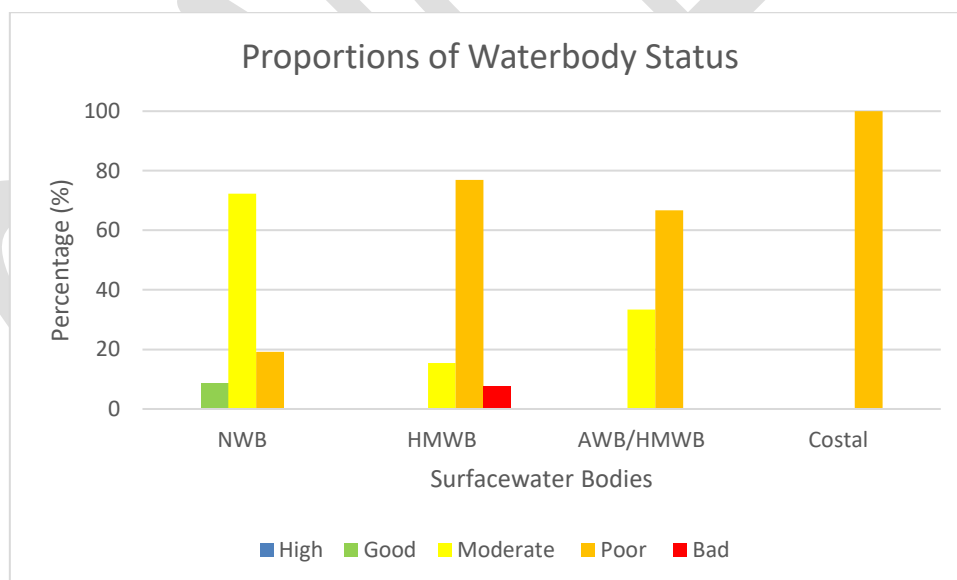


Figure 24 - Proportional distribution of assessed waterbody status classes across the main surface water body categories within the Drin-Buna River Basin

Figure 24 indicates a clear predominance of less-than-good ecological or overall status across all waterbody categories, with “Poor” and “Moderate” classes dominating the basin assessment. Natural Water Bodies (NWB) show the most balanced distribution, although the majority remain in Moderate status (approximately 72%), while only a small proportion achieve Good status (around 8%). About 19% of NWBs are classified as Poor, indicating that significant ecological pressures are already affecting a large share of natural systems.

Heavily Modified Water Bodies (HMWB) exhibit substantially worse conditions. Approximately 77% are classified as Poor, while only around 15% remain at Moderate status and a smaller fraction (about 8%) fall into Bad status. No HMWBs achieve Good or High status, reflecting the strong influence of hydro morphological alteration, hydropower regulation, channel modification, and flow disruption associated with artificial or heavily regulated systems.

Artificial and heavily modified combined water bodies (AWB/HMWB) also display degraded conditions, with roughly two-thirds classified as Poor and one-third as Moderate. The absence of Good or High status indicates that structural hydro morphological pressures and operational water management constraints continue to dominate ecological functioning.

Coastal waters show the most critical condition, with 100% classified as Poor. This suggests cumulative downstream impacts from the entire river basin, including nutrient enrichment, untreated urban wastewater discharges, sediment alteration, diffuse agricultural pollution, and reduced ecological resilience in transitional and coastal ecosystems.

Overall, the assessment demonstrates a strong deterioration gradient from natural inland systems toward modified and downstream receiving environments. The near absence of Good ecological status and the complete absence of High status across all categories indicate that basin-wide pressures are both widespread and cumulative. The results further confirm that hydro morphological alteration, wastewater pollution, diffuse agricultural inputs, and altered flow regimes are the principal drivers preventing achievement of WFD environmental objectives.

The screening assessment identifies water bodies at risk of failing WFD environmental objectives based on pressure analysis, available monitoring data, hydro morphological assessment, and expert judgement.

10.4.9 Surface Waterbodies classified as At Risk

The “At Risk” classification identifies water bodies that are unlikely to achieve the environmental objectives of the WFD without the implementation of significant management measures. In the Drin–Buna River Basin, most of water bodies classified as “At Risk” are heavily influenced by hydropower regulation, hydro morphological alteration, sediment disruption, transboundary pressures, and cumulative anthropogenic impacts.

These water bodies should be prioritized in the Programme of Measures and monitoring network design.

Table 47 - Surface Water bodies classified as At Risk.

IDENTIFICATION			RISK ASSESSMENT		
WATERBODY NAME	WATERBODY EU CODE	FORM	OVERALL STATUS	RISK LEVEL	Confidence Level
Liqeni i Fierzës	LW3510701	HMWB	4	At Risk	3
Liqeni i Vaut të Dejës	LW3510302	AWB/HMWB	4	At Risk	3
Liqeni i Komanit	LW3510301	AWB/HMWB	4	At Risk	3
Lumi i Bunës	TW3510101	HMWB	4	At Risk	2
Grykëderdhja Bunë	CW3510101	Coastal	4	At Risk	1
Lumi i Gjadërit, Lezhë	35114	NWB	4	At Risk	1
Lumi i Drinit të Lezhës, poshtëm	35111	NWB	4	At Risk	1
Lumi i Valbonës Siperme	3510642	NWB	4	At Risk	2
Lumi i Lumës	351084	NWB	4	At Risk	2
Lumi i Gjadërit	3510322	NWB	4	At Risk	2
Lumi Drini i Zi - 1	3510973	HMWB	4	At Risk	2
Lumi Drini i Zi Transboundary	351099	HMWB	4	At Risk	2
Lumi Drini i Zi - 4	3510933	HMWB	4	At Risk	1
Lumi Drini i Zi - 6	351091	HMWB	4	At Risk	2
Lumi Drini i Bardhe	351082	HMWB	4	At Risk	1
Lumi Drini i Zi - 2	3510971	HMWB	4	At Risk	1
Lumi Drini i Zi - 5	3510931	HMWB	4	At Risk	1
Lumi i Drinit të Lezhës, sipërm	35112	NWB	4	At Risk	1
Lumi Drin - Ashte	3510321	HMWB	4	At Risk	2
Lumi Drin - Kir - Bune	351031	NWB	4	At Risk	1

The assessment demonstrates that hydromorphological pressures are the dominant driver of risk throughout the basin. A large proportion of the classified water bodies are designated as Heavily Modified Water Bodies (HMWBs), particularly within the Drin cascade and the Drini i Zi system. The hydropower reservoirs of Fierza, Koman, and Vau i Dejës represent the most significantly modified systems in the basin and are all classified as “At Risk” with relatively high confidence (level 3). These reservoirs fundamentally alter:

- natural flow regimes,
- sediment transport continuity,
- ecological connectivity,
- thermal stratification,
- and aquatic habitat conditions.

The Drin cascade exerts cumulative downstream impacts extending through the Buna River and into the Adriatic coastal zone. The classification of the Buna transitional water body and the Buna river mouth coastal water body as “At Risk” reflects the combined influence of:

- altered freshwater discharge,
- sediment retention upstream,
- nutrient transport,
- coastal hydrodynamic changes,
- salinity intrusion,
- and ecological degradation of transitional and coastal habitats.

Several rivers stretches within the Drini i Zi system are also classified as “At Risk,” reflecting pressures associated with:

- hydropower regulation,
- abstraction,
- channel alteration,
- sediment imbalance,
- mining activities,
- and transboundary upstream impacts originating outside Albanian territory.

The repeated classification of Drini i Zi water bodies as HMWBs indicates substantial physical modification of river systems and reduced hydro morphological integrity. Confidence levels of 1 and 2 suggest that although significant pressures are evident, ecological monitoring and pressure quantification remain partially constrained by limited datasets and monitoring coverage.

Natural river water bodies, including the Gjadër, Lezha Drin, Valbona, and Luma rivers, are also classified as “At Risk.” In these systems, pressures are linked to:

- gravel extraction,
- hydromorphological alterations,
- local wastewater discharges,
- diffuse agricultural pollution,
- erosion and sediment transport,
- and habitat fragmentation.

The Valbona and upper mountainous tributaries additionally face increasing pressure from hydropower development, tourism expansion, and local abstraction activities, which may progressively affect ecological integrity if unmanaged.

The classification of the Drin–Kir–Buna system as “At Risk” illustrates the cumulative downstream interaction between regulated hydrological systems, tributary pressures, and floodplain modifications. These interconnected systems are particularly sensitive to changes in ecological flow, sediment transport, and floodplain connectivity.

Overall, the assessment confirms that the Drin–Buna Basin is strongly characterised by large-scale hydromorphological alteration and cumulative basin-wide pressures. The predominance of “At Risk” classifications highlight the urgent need for:

- ecological flow implementation,

- sediment management measures,
- restoration of river continuity,
- strengthened transboundary coordination,
- enhanced monitoring programmes,
- improved wastewater management,
- and tighter control of hydropower and extraction activities.

10.4.10 Surface Waterbodies classified as Possibly at Risk

Water bodies in this category require further investigation and targeted monitoring. In line with the precautionary principle, they should be operationally treated as At Risk until sufficient evidence demonstrates otherwise.

Table 48 Surface Water bodies classified as Possibly at Risk – Drin-Buna River Basin

IDENTIFICATION			RISK ASSESSMENT		
WATERBODY NAME	WATERBODY EU CODE	FORM	OVERALL STATUS	RISK LEVEL	CL
Liçeni i Prespës së Vogël	LW3510901	NWB	2	Possibly at risk	2
Liçeni i Prespës së Madhe	LW3510902	NWB	3	Possibly at risk	2
Liçeni i Ohrit	LW3510903	NWB	3	Possibly at risk	3
Liçeni i Murtemës	LW3510101	NWB	3	Possibly at Risk	1
Liçeni i Shkodrës	LW3510201	NWB	2	Possibly at Risk	2
Liçeni i Merxhanit	TW3511102	NWB	2	Possibly at Risk	1
Lumi Drini i Lezhës	TW3511101	HMWB	3	Possibly at Risk	1
Velipojë-Mali Rrencit	CW3510102	NWB	3	Possibly at Risk	1
Përroi i Thatë	351024	NWB	3	Possibly at Risk	1
Lumi i Cemit poshtem	351026	NWB	3	Possibly at Risk	1
Përroi i Murres	3510972	NWB	3	Possibly at Risk	1
Lumi i Gashit	3510644	NWB	3	Possibly at Risk	1
Lumi i Bushtricës	351062	NWB	3	Possibly at Risk	2
Lumi i Bushtricës në Drinin e Zi	351092	NWB	3	Possibly at Risk	2
Lumi i Krumës	351076	NWB	3	Possibly at Risk	1
Lumi i Shalës	35104-2	NWB	3	Possibly at Risk	1
Lumi i Kirit, rrjedha e poshtme	351034-2	NWB	3	Possibly at Risk	1
Lumi i Sapaçit	3510326	NWB	3	Possibly at Risk	2
Lumi Cemi i Selcës	3510264	NWB	3	Possibly at Risk	2
Lumi i Thethit	35104-1	NWB	3	Possibly at Risk	1
Lumi i Bunës downstream	35101	NWB	3	Possibly at Risk	1
Lumi i Dardhës	3510714	NWB	3	Possibly at Risk	2
Lumi i Vermoshit	3591	NWB	3	Possibly at Risk	1
Lumi i Mashit	3510712	NWB	3	Possibly at Risk	1
Lumi i Gomsiqes	3510324	NWB	3	Possibly at Risk	2
Lumi Molla e Lurës	3510922	NWB	3	Possibly at Risk	2
Lumi i Veleshicës	351094	NWB	3	Possibly at Risk	2
Lumi Zalli i Bulqizës	351098	NWB	3	Possibly at Risk	2
Lumi i Selës	351096	NWB	3	Possibly at Risk	2
Lumi i Valbonës poshtme	351061	NWB	3	Possibly at Risk	1
Përroi i Kalimashit	351078	NWB	3	Possibly at Risk	1
Përroi i Serriqes	351074	NWB	3	Possibly at Risk	2
Përroi i Skatinës	351072	NWB	3	Possibly at Risk	1
Lumi Drini i Zi - 3	351095	HMWB	3	Possibly at Risk	1
Lumi i Valbonës ne rrjedhen e mesme	3510641	NWB	3	Possibly at Risk	2
Lumi i Cemit siperm	3510262	NWB	3	Possibly at risk	2
Lumi i Bunës - Liçeni Shkodres	351021	HMWB	3	Possibly at Risk	1
Lumi i Kirit, rrjedha e sipërme	351034-1	NWB	3	Possibly at Risk	1
Lumi i Currajt	35105	NWB	3	Possibly at Risk	1

The risk assessment results indicate that a very large proportion of the lake, river, transitional and coastal water bodies within the basin are classified as “Possibly at Risk”, reflecting significant uncertainty linked to insufficient monitoring data, limited biological and chemical datasets, and incomplete pressure-impact validation. At the same time, the classification also suggests that these water bodies are exposed to multiple anthropogenic pressures that may compromise the achievement of the WFD environmental objectives if no preventive management measures are implemented.

The assessment shows that most water bodies are classified with an overall status level of 3 (moderate concern), while a smaller number are classified at level 2, indicating comparatively lower but still notable pressure exposure. Confidence levels (CL) are predominantly low to moderate (1–2), further emphasizing the need for improved monitoring coverage, ecological assessment, hydromorphological surveys, and chemical surveillance throughout the basin.

Among the lake water bodies, the transboundary systems of Lake Ohrid, Lake Prespa and Lake Shkodër are all classified as “Possibly at Risk.” These internationally shared lakes are environmentally sensitive systems exposed to pressures associated with:

- untreated or partially treated wastewater discharges,
- tourism development,
- diffuse agricultural pollution,
- shoreline modification,
- hydrological alterations,
- and climate-related impacts on water levels and ecological dynamics.

Lake Ohrid presents a relatively higher confidence level (CL=3), indicating that more monitoring information is available compared to many other water bodies in the basin. However, the classification still reflects concerns regarding nutrient enrichment, urban expansion, and increasing tourism pressure along the shoreline.

The hydromorphologically modified systems, including Drini i Lezhës and the Buna River–Lake Shkodra connection, are classified as HMWBs and remain “Possibly at Risk” primarily due to:

- hydropower regulation,
- altered flow regimes,
- channel modifications,
- sediment transport interruption,
- and flood protection infrastructure.

The riverine systems demonstrate a widespread pattern of precautionary classification. Mountain tributaries such as Valbona River, Shala River, Theth River and Cemi River generally maintain relatively good natural characteristics but are still classified as “Possibly at Risk” because of:

- localized hydropower development pressures,
- gravel extraction,
- deforestation and erosion,
- tourism expansion,
- road construction,
- and insufficient ecological monitoring data.

Several tributaries draining mining or mineralized areas, including Zalli i Bulqizës and connected tributary systems in the Drin basin, are associated with additional risks related to:

- suspended solids,
- sediment transport,
- potential heavy metal contamination,
- and hydromorphological instability.

The transitional and coastal water bodies, including Velipojë–Mali i Rrencit Coastal Water and Merxhani Transitional Water, are also classified as “Possibly at Risk,” reflecting the cumulative impacts of:

- riverine pollution transport,
- nutrient loading,
- coastal erosion,
- saline intrusion,
- habitat degradation,
- and seasonal tourism pressures.

10.4.11 Surface Waterbodies classified as Unknown Status

Water bodies in this category are waterbodies for which we have zero or not official/unverified data, but where significant pressures seem likely. These waterbodies require further investigation and targeted monitoring. In line with the precautionary principle, they should be operationally treated as At Risk until sufficient evidence demonstrates otherwise.

Table 49 - Water bodies classified as Unknown Status – Drin-Buna River Basin.

IDENTIFICATION			RISK ASSESSMENT		
WATERBODY NAME	WATERBODY EU CODE	FORM	OVERALL STATUS	RISK LEVEL	CL
Ujëmbledhësi i Shtodrit	LW35103401	AWB/HMWB	3	Unknown	1
Laguna e Vilunit	TW3510102	NWB	3	Unknown	1
Ishull-Lezha	CW3511102	NWB	4	Unknown	1
Shëngjin	CW3511101	NWB	4	Unknown	1
Përroi i Varkës	351022	NWB	2	Unknown	1

The consistently low confidence level (CL=1) across all listed water bodies confirms that the present assessment is affected by substantial uncertainty and that additional investigations are required before a reliable classification can be established.

Among the assessed systems, the artificial/heavily modified water body Ujëmbledhësi i Shtodrit is classified as “Unknown” despite having an overall status level of 3. This classification reflects uncertainty regarding:

- ecological flow conditions,
- reservoir operational impacts,
- sediment dynamics,
- and biological response to hydromorphological alteration.

As an AWB/HMWB system, the reservoir is likely influenced by water regulation and hydrological modification, but the absence of sufficient ecological monitoring prevents a conclusive assessment of its risk status.

The transitional water body Laguna e Vilunit also remains under “Unknown” status. Transitional and lagoon ecosystems are typically highly sensitive to:

- nutrient enrichment,
- saline intrusion,
- sedimentation,
- hydrological connectivity changes,
- and tourism-related pressures.

However, in this case, the lack of systematic ecological and physicochemical monitoring data limits the ability to determine the actual degree of environmental risk.

The coastal water bodies Ishull–Lezha Coastal Water and Shëngjin Coastal Water show the highest overall status concern level (4), yet they remain classified as “Unknown” due to inadequate evidence for formal risk determination. These coastal systems are potentially exposed to cumulative pressures associated with:

- urban wastewater discharges,
- port and tourism activities,
- marine litter,
- coastal erosion,
- diffuse pollution from river inflows,
- and habitat disturbance.

The elevated status level suggests potentially significant environmental pressures, but the current monitoring framework is insufficient to verify ecological and chemical conditions with confidence. Similarly, Përroi i Varkës is classified as “Unknown” with an overall status level of 2, indicating comparatively lower apparent pressure levels. Nevertheless, the lack of monitoring information prevents

confirmation of whether the water body is genuinely at low risk or whether important pressures remain unidentified.

10.5 Summary status assessment of Surface Waterbodies

The Drin–Buna River Basin exhibits a strongly coupled and longitudinally connected multi-pressure system dominated by hydropower regulation, sediment continuity disruption, urban wastewater discharges, and diffuse agricultural pollution. These pressures act cumulatively and synergistically, resulting in progressive downstream amplification of ecological impacts across the river–lake–reservoir–delta continuum.

Upstream hydro morphological alterations and pollution sources propagate downstream through altered flow regimes, sediment transport disruption, and contaminant transfer processes, ultimately affecting Lake Shkodër, the Buna River corridor, transitional waters, and coastal systems.

Basin-wide pressure behaviour and ecological response

The basin is characterised by interacting physical, chemical, and hydrological stressors, including:

- hydropower-driven flow alteration,
- sediment trapping and continuity disruption,
- urban wastewater discharges,
- diffuse agricultural pollution,
- mining-related sediment and contaminant mobilisation,
- channelisation and floodplain disconnection, and
- solid waste and litter inputs.

These pressures are not isolated but mutually reinforcing. Hydrological regulation reduces natural variability and sediment transport capacity; sediment retention in reservoirs leads to downstream sediment starvation; nutrient inputs from urban and agricultural sources increase eutrophication risk; and flood events amplify the transport of pollutants and sediments toward lowland, lacustrine, and coastal environments. The cumulative effect is a measurable reduction in ecosystem resilience, habitat heterogeneity, and ecological integrity across all water body types.

Risk Screening Outcome

Based on pressure-based assessment, expert judgement, and available monitoring evidence, the basin-wide classification indicates:

- Most water bodies are At Risk of failing WFD environmental objectives;
- Upstream lake and headwater systems are Potentially at Risk, reflecting moderate pressure intensity combined with data uncertainty; and
- Downstream transitional and coastal waters are at High Risk, due to cumulative basin-scale loading and morphological instability.

Under current conditions, achievement of Good Ecological Status (GES) or Good Ecological Potential (GEP) is unlikely without coordinated basin-scale intervention.

Most environmentally sensitive systems

The assessment identifies the following as the most vulnerable components of the basin system:

- the Drin hydropower cascade and regulated river corridor;
- Lake Shkodër and the Buna River system;
- transitional and coastal waters of the Buna delta;
- Drini i Zi mining-affected tributaries;
- lowland drainage and intensively modified agricultural systems; and
- Lake Ohrid and Lake Prespa nearshore and inflow zones.

These systems either concentrate multiple pressures or function as downstream integrators of basin-wide impacts.

Monitoring uncertainty and data limitations

Significant limitations in the current monitoring framework reduce confidence in ecological classification and risk attribution. Key gaps include:

- insufficient biological quality element monitoring;
- incomplete hydromorphological assessment coverage;
- limited chemical surveillance for priority substances in selected systems;
- weak groundwater monitoring integration;
- inadequate hydrological time-series data in regulated and lowland systems;
- limited event-based sampling (floods, hydropeaking, first-flush pollution); and
- fragmented data management and basin-wide integration systems.

As a result, several short-duration but ecologically significant processes—such as hydropeaking impacts, oxygen depletion events, sediment remobilisation, and flood-driven pollutant pulses—are likely underrepresented in current datasets. Strengthening the monitoring network is therefore a core requirement under the RBMP Programme of Measures, improving knowledge base and reducing uncertainty.

Dominant basin-scale pressures

The principal significant pressures affecting surface water bodies in the basin are:

- Hydropower regulation and hydro morphological alteration (3.1, 3.3, 3.4, 3.5)
- Urban wastewater discharges (1.1)
- Diffuse agricultural pollution (2.1, 2.5)
- Mining and quarrying impacts (1.4)
- Floodplain disconnection and channel modification (3.3 / 4.x)
- Solid waste and litter inputs (1.5, 2.10)

All surface water categories are affected, including rivers, lakes, reservoirs, transitional waters, and coastal systems.

Basin-wide system behaviour

The Drin–Buna Basin operates as a highly connected hydrological system characterised by:

- cumulative downstream amplification of pressures;
- progressive sediment deficit from headwaters to coastal zones;
- nutrient accumulation in low-energy systems (lakes, floodplains, estuaries);
- reduced morphological dynamics and habitat diversity;
- increasing ecological homogenisation and dominance of pollution-tolerant taxa.

These processes confirm that ecological status cannot be interpreted at local scale only, but must be understood as a basin-integrated response system.

Overall WFD risk classification

The integrated WFD Article 5 screening yields for the Drin River Basin provides a basin-wide classification based on the severity of environmental and structural threats. The following table re-arranges these classifications to highlight the direct relationship between geographical areas, their risk status, and the specific factors—such as hydropower infrastructure and nutrient loading—that drive these risks.

The assessment highlights the following:

- **Infrastructure Impact:** There is a definitive link between the hydropower cascade in the upper reaches and the resulting morphological changes and pollution accumulation in the lowlands and coastal regions.
- **Hydrological Variability:** Changes in flow regimes due to dam operations significantly influence the natural intra-annual water distribution, increasing the risk of extreme phenomena like floods.

Table 50 - Overview of the geographical areas per risk category, based on the key risk drivers.

Risk Category	Geographical Areas	Key Drivers of Risk
At High Risk	Kaskada e Drinit, Drin–Buna lowlands, transitional waters, coastal waters	Hydromorphological changes from hydropower dams (Kaskada e Drinit) and significant flooding/pollution in the lowlands.

At Risk	Drini i Zi sub-basin and regulated tributary systems	Intense regulation of water flow and local pollution sources.
Potentially At Risk	Shkodra Lake, Ohrid–Prespa sub-basin, and specific upstream tributaries	Nutrient loading (eutrophication) and potential habitat degradation, though some areas require more data for a definitive "At Risk" status.

Confidence in identifying “Not at Risk” water bodies remains limited due to monitoring gaps and system-wide connectivity effects.

Conclusions

The Drin–Buna River Basin is subject to a complex and spatially cascading multi-pressure regime dominated by hydropower regulation, sediment continuity disruption, urban wastewater discharges, diffuse agricultural pollution, mining impacts, and hydro morphological modification.

These pressures interact across spatial and temporal scales, producing cumulative downstream ecological degradation across all water body types. The resulting ecological signature includes reduced hydrological variability, sediment starvation in downstream systems, increased nutrient enrichment and eutrophication risk, loss of floodplain connectivity, and progressive simplification of aquatic habitats. The assessment demonstrates that, under current conditions, a substantial proportion of surface water bodies are unlikely to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) within the current RBMP cycle.

Accordingly, the findings provide a strong evidentiary basis for the Programme of Measures, which must prioritise:

- restoration of hydro morphological continuity and ecological flows;
- improvement of sediment continuity;
- upgrading of urban wastewater treatment infrastructure;
- reduction of diffuse agricultural pollution;
- strengthening of groundwater and abstraction management;
- enhancement of hydrometeorological and ecological monitoring systems;
- improved institutional coordination; and
- strengthened transboundary river basin governance.

Without coordinated and adequately financed implementation of these measures, the majority of water bodies within the Drin–Buna River Basin are unlikely to achieve WFD environmental objectives. Table 51 gives the overall status assessment of all the water bodies within the Drin–Buna River basin.

The Pressures Assessment at sub-basin level / waterbody level has been carried out following the enumeration list for ‘risk’ categories below:

- ‘Not at Risk’: data or expert judgement supports that the waterbody is very unlikely to be at risk; status can only be 1 or 2.
- ‘Possibly at Risk’: data or expert judgement suggests that the waterbody is likely to be at risk; status 2 or 3.
- ‘At Risk’: on basis of either PCHEM data or very significant pressures, its certain that the waterbody is not at Good or even Moderate status. Status must therefore be 4 or 5.
- ‘Unknown’ should be used where there is no data but where significant pressures seem likely. Status could be 2 or 3 or to be 4 or 5 if we have data.

Table 51 - Pressures and Status Assessment – Category RIVERS, LAKES, COSTAL, and AWB within Drin -Buna River Basin.

IDENTIFICATION			PRESSURE ANALYSIS ⁹³								STATUS ASSESSMENT						RISK ASSESSMENT	
WATERBODY NAME	WATERBODY EU CODE	FORM	POINT PRESSURE 1	POINT PRESSURE 2	DIFFUSE PRESSURE 1	DIFFUSE PRESSURE 2	ABSTRACTION PRESSURE 1	ABSTRACTION PRESSURE 2	MORPHOLOGY PRESSURE	HYDROMORPH PRESSURE	BQES EQ ⁹⁴	P-CHEM ⁹⁵	H-MORPH - HMOJ (PC-U) ⁹⁶	ANNEX X PSs ⁹⁷	ANNEX VIII RBSP	OVERALL STATUS	RISK LEVEL ⁹⁸	CL ⁹⁹
Liçeni i Prespës së Vogël	LW3510 901	NWB				2.2		3.1				2	2		5	2	Possibly at risk	2
Liçeni i Prespës së Madhe	LW3510 902	NWB	1.3	1.4		2.2; 2.5		3.1 and 3.2				2	2		5	3	Possibly at risk	2
Liçeni i Ohrit	LW3510 903	NWB	1.3	1.6	2.5	2.2 and 2.6				4.1.4	3	2	2		5	3	Possibly at risk	2
Liçeni i Fierzës	LW3510 701	HMWB	1.1	1.4; 1.7				3.5		4.2.1; 4.3.3		2	2		5	4	At Risk	2
Liçeni i Vaut të Dejës	LW3510 302	AWB/H MWB		1.4; 1.9	2.2			3.5		4.2.4		2	2		5	4	At Risk	2
Liçeni i Komanit	LW3510 301	AWB/H MWB						3.5		4.2.1		2	2		5	4	At Risk	2
Liçeni i Murtemës	LW3510 101	NWB			2.2								3			3	Possibly at Risk	1
Liçeni i Shkodrës	LW3510 201	NWB	1.1	1.6; 1.7	2.2						2	2	2		5	2	Possibly at Risk	2
Ujëmbledhësi i Shtodrit	LW3510 3401	AWB/H MWB											3			3	Unknown	1
Liçeni i Merxhanit	TW3511 102	NWB		1.4									3		5	2	Possibly at Risk	1
Laguna e Vilunit	TW3510 102	NWB													5	3	Unknown	1
Lumi Drini i Lezhës	TW3511 101	HMWB			2.2							4	4		5	3	Possibly at Risk	1
Lumi i Bunës	TW3510 101	HMWB		1.4; 1.6; 1.7; 1.9	2.2						4	2	4		5	4	At Risk	2

⁹³ Pressure Types align with WISE GIS Reporting Guidance 2016 – Annex 1a

⁹⁴ Comment on BQE method

⁹⁵ Comment on P-CHEM data – P-CHEM status assessment based principally on spot sampling of July 2019, utilising BOD₅ and/or NH₄ values as indicator values.

⁹⁶ Comment on H-MORPH methodology – MORPHOLOGY indicates significant obstruction of watercourses or changes in river morphology due to physical or mining alterations; HYDROMORPH indicates significant change in flow regime due to municipal, irrigation or hydropower abstractions.

⁹⁷ Priority Substances if monitored

⁹⁸ Enumeration List for Risk = Not at Risk; At Risk; Possibly at Risk; Unknown.

⁹⁹ Enumeration List for Confidence Level = '0' = no information; '1' = low confidence; '2' = medium confidence; '3' = high confidence. Low = no monitoring data, expert judgement only; Medium = some supporting quality element (QE) data and limited data on one BQE; High = good data on 1+ BQE and supporting most relevant QEs.

Velipojë-Mali Rrencit	CW3510102	NWB										2			5	3	Possibly at Risk	1
Ishull-Lezha	CW3511102	NWB										4			5	4	Unknown	1
Shëngjin	CW3511101	NWB										4			5	4	Unknown	1
Grykëderdhja Bunë	CW3510101	Coastal	1.1									3			5	4	At Risk	1
Përroi i Thatë	351024	NWB		1.4	2.2							2	4		5	3	Possibly at Risk	1
Përroi i Varkës	351022	NWB											4			2	Unknown	1
Lumi i Cemit poshtem	351026	NWB										2	3		5	3	Possibly at Risk	1
Përroi i Murres	3510972	NWB						3.5	4.1.2				4		5	3	Possibly at Risk	1
Lumi i Gjadërit, Lezhë	35114	NWB		1.4	2.2							4	4		5	4	At Risk	1
Lumi i Drinit të Lezhës, poshtëm	35111	NWB	1.1	1.4								4	5		5	4	At Risk	1
Lumi i Valbonës Siperme	3510642	NWB						3.5	4.1.2	4.2.1		3	3		5	4	At Risk	2
Lumi i Lumës	351084	NWB						3.5	4.1.2	4.2.1		4	3		5	4	At Risk	2
Lumi i Gashit	3510644	NWB		1.7								3	2		5	3	Possibly at Risk	1
Lumi i Bushtricës	351062	NWB						3.5	4.1.2	4.2.1		2	3		5	3	Possibly at Risk	2
Lumi i Bushtricës në Drinin e Zi	351092	NWB		1.4				3.5	4.1.2	4.2.1		2	3		5	3	Possibly at Risk	2
Lumi i Krumës	351076	NWB										2	3		5	3	Possibly at Risk	1
Lumi i Shalës	35104-2	NWB										2	2		5	3	Possibly at Risk	1
Lumi i Kirit, rrjedha e poshtme	351034-2	NWB		1.4; 1.7								3	4		5	3	Possibly at Risk	1
Lumi i Sapaçit	3510326	NWB						3.5	4.1.2	4.2.1		2	2		5	3	Possibly at Risk	2
Lumi Cemi i Selcës	3510264	NWB						3.5	4.1.2	4.2.1		2	3		5	3	Possibly at Risk	2
Lumi i Thethit	35104-1	NWB	1.1									2	2		5	3	Possibly at Risk	1
Lumi i Gjadërit	3510322	NWB			2.2			3.5	4.1.2	4.2.1		3	4		5	4	At Risk	2
Lumi i Bunës downstream	35101	NWB	1.1		2.2						3	2	4		5	3	Possibly at Risk	1
Lumi i Dardhës	3510714	NWB						3.5	4.1.2	4.2.1		2	3		5	3	Possibly at Risk	2
Lumi i Vermoshit	3591	NWB										2	3		5	3	Possibly at Risk	1
Lumi i Mashit	3510712	NWB										2	3		5	3	Possibly at Risk	1
Lumi i Gomsiqes	3510324	NWB		1.7	2.2	2.4		3.5	4.1.2	4.2.1		2	3		5	3	Possibly at Risk	2

Lumi Molla e Lurës	351092 2	NWB					3.5	4.1.2	4.2.1		2	4		5	3	Possibly at Risk	2
Lumi i Veleshicës	351094	NWB					3.5	4.1.2	4.2.1		2	3		5	3	Possibly at Risk	2
Lumi Zalli i Bulqizës	351098	NWB		1.7; 1.9			3.5	4.1.2	4.2.1		2	4		5	3	Possibly at Risk	2
Lumi i Selës	351096	NWB					3.5	4.1.2	4.2.1		2	4		5	3	Possibly at Risk	2
Lumi Drini i Zi - 1	351097 3	HMWB		1.4			3.5	4.1.2	4.2.1	3	2	5		5	4	At Risk	2
Lumi Drini i Zi Transboundary	351099	HMWB		1.4			3.5	4.1.2	4.2.1		2	4		5	4	At Risk	2
Lumi Drini i Zi - 4	351093 3	HMWB		1.4							2	5		5	4	At Risk	1
Lumi Drini i Zi - 6	351091	HMWB		1.4			3.5	4.1.2	4.2.1		2	4		5	4	At Risk	2
Lumi Drini i Bardhe	351082	HMWB								4	3	4		5	4	At Risk	1
Lumi i Valbonës poshtme	351061	NWB		1.4; 1.7							2	4		5	3	Possibly at Risk	1
Perroi i Kalimashit	351078	NWB		1.7							2	3		5	3	Possibly at Risk	1
Perroi i Serriqes	351074	NWB					3.5	4.1.2	4.2.1		2	2		5	3	Possibly at Risk	2
Përroi i Skatinës	351072	NWB		1.7			3.5	4.1.2	4.2.1		2	3		5	3	Possibly at Risk	1
Lumi Drini i Zi - 2	351097 1	HMWB		1.4						2	2	5		5	4	At Risk	1
Lumi Drini i Zi - 3	351095	HMWB					3.5	4.1.2	4.2.1		2	5		5	3	Possibly at Risk	1
Lumi Drini i Zi - 5	351093 1	HMWB		1.7							2	5		5	4	At Risk	1
Lumi i Valbonës ne rrjedhen e mesme	351064 1	NWB					3.5	4.1.2	4.2.1		2	2		5	3	Possibly at Risk	2
Lumi i Cemit siperm	351026 2	NWB					3.5	4.1.2	4.2.1		2	3		5	3	Possibly at risk	2
Lumi i Bunës - Ligeni Shkodres	351021	HMWB	1.1	1.4							2	4		5	3	Possibly at Risk	1
Lumi i Kirit, rrjedha e sipërme	351034- 1	NWB	1.1	1.7							2	3		5	3	Possibly at Risk	1
Lumi i Drinit te Lezhes, sipërm	35112	NWB		1.4; 1.6	2.2						4	4		5	4	At Risk	1
Lumi Drin - Ashte	351032 1	HMWB		1.4	2.2		3.5	4.1.2	4.2.1	5	2	4		5	4	At Risk	2
Lumi i Currajt	35105	NWB					3.5	4.1.2	4.2.1		2	2		5	3	Possibly at Risk	1
Lumi Drin - Kir - Bune	351031	NWB					3.5	4.1.2	4.2.1		2	4		5	4	At Risk	1

10.6 Groundwater body Pressures and Status Assessment

This chapter presents the pressure and impact analysis for groundwater bodies (GWBs) and associated springs within the Drin-Buna River Basin. It follows the requirements of the WFD Article 5 and Annex II and applies a pressure-based risk screening approach appropriate to a data-scarce environment. The analysis considers:

- hydrogeological setting and aquifer type;
- groundwater vulnerability;
- identified anthropogenic pressures;
- likely pressure pathways and receptors; and
- available monitoring and expert evidence.

The assessment distinguishes between:

- intergranular aquifers in lowland and coastal areas;
- compact and fractured aquifers;
- karst groundwater systems and associated springs.

Groundwater pressures are spatially heterogeneous and generally localized rather than basin wide. Accordingly, the assessment focuses on identifying groundwater bodies and groundwater management units (GMUs) where pressures may compromise WFD environmental objectives.

10.6.1 Status Assessment at Groundwater Management Unit Level

Drini i Zi Groundwater Management Unit

The Drini i Zi sub-basin is dominated by compact and fractured aquifers, including karstified carbonate formations that support numerous springs and provide important local water supplies. These systems are generally characterized by:

- good natural recharge conditions;
- relatively limited urban and agricultural pressure;
- high local vulnerability where rapid groundwater flow paths occur in fractured or karst formations.

Identified pressures are spatially limited and include:

- groundwater and spring abstractions for public supply;
- localized mining and quarrying pressures;
- limited agricultural activities within valley-floor deposits.

Mining-related pressures are locally significant where fractured aquifers increase infiltration vulnerability and where groundwater pathways connect recharge areas to springs or shallow wells.

Overall, the Drini i Zi Groundwater Management Unit is assessed as **Possibly at Risk**, reflecting:

- generally low to moderate pressure intensity;
- localized abstraction and mining hotspots; and
- limited monitoring evidence available to confirm impacts.

The assessment indicates that only a subset of groundwater bodies and springs are likely to be significantly affected.

Kaskada e Drinit (Drin Cascade) Groundwater Management Unit

The Kaskada e Drinit (Drin Cascade) Groundwater Management Unit includes mountainous and foothill groundwater systems associated with major hydropower reservoirs and regulated river reaches. Aquifers are predominantly compact and fractured, with springs contributing to local supply and river baseflow.

Groundwater pressures are mainly indirect and localized and include:

- abstractions for drinking-water supply;
- localized groundwater-level alteration;
- modified groundwater–surface water interaction near reservoirs and regulated river reaches.

There is limited evidence of widespread diffuse pollution affecting groundwater quality. Given the absence of extensive basin-wide pressures and the localized nature of observed impacts, the Kaskada e Drinit GMU is assessed overall as: **Not at Risk to Possibly at Risk**.

The main uncertainty relates to:

- reservoir-induced groundwater interaction effects;
- limited groundwater-level and spring-discharge monitoring.

Drin–Bunë Groundwater Management Unit (Lower Basin and Coastal Plain)

The Drin–Buna lower basin contains intergranular aquifers in lowland and coastal areas hydraulically connected to shallow groundwater systems, drainage canals, wetlands and coastal receptors. These aquifers are important for:

- public water supply;
- irrigation;
- agricultural production.

Compared to upland groundwater systems, these aquifers are more exposed to anthropogenic activities and pollution pathways.

Key pressures include:

- urban wastewater infiltration;
- diffuse agricultural pollution;
- abstraction for irrigation and water supply;
- localized industrial and contaminated-site pressures;
- groundwater-level alteration in coastal and lowland areas.

Pressure intensity is not spatially uniform. The highest vulnerability occurs in:

- shallow alluvial aquifers;
- intensively cultivated areas;
- urbanized coastal zones;
- locations with unsewered settlements and drainage networks.

Considering the concentration of pressures in vulnerable intergranular aquifers, the Drin–Bunë Groundwater Management Unit is assessed overall as: **Possibly at Risk**.

The assessment supports targeted investigation and measures focused on identified hotspots rather than basin-wide intervention.

Ohrid–Prespa Groundwater Management Unit

The Ohrid–Prespa area is characterized by extensive karst groundwater systems with strong hydraulic connectivity between recharge areas, groundwater bodies, springs and lakes. These systems have:

- high ecological and hydrological importance;
- transboundary significance;
- high aquifer sensitivity due to rapid groundwater transport pathways.

Identified pressures include:

- localized urban wastewater infiltration;
- diffuse agricultural activities within recharge zones;
- localized abstraction pressures.

Although pressures are spatially limited, karst vulnerability significantly increases the potential for groundwater impact and rapid pollutant transport.

On a pressure-based assessment, the Ohrid–Prespa GMU is classified overall as: **Possibly At Risk**.

This classification reflects:

- localized pressures;
- high aquifer sensitivity;
- limited monitoring coverage and uncertainty.

At the scale of the entire Drin–Bunë River Basin, groundwater pressures are heterogeneous and predominantly localized. No evidence indicates a uniform basin-wide pressure affecting all groundwater bodies. The basin-wide groundwater system is therefore assigned an overall pressure-based classification of **Possibly at Risk**.

This assessment reflects:

- localized pressure hotspots;
- vulnerable lowland and karst aquifers;
- mining-related groundwater risks;
- uncertainty associated with limited monitoring data.

The assessment supports a management approach based on:

- targeted monitoring;
- groundwater-body-scale investigations;
- receptor-based assessment;
- prioritization of vulnerable groundwater bodies and springs.

10.6.2 Status Assessment at Groundwater Body Level

Quantitative status

Quantitative status assessment evaluates whether groundwater abstraction and hydrological alteration are causing, or are likely to cause, long-term deterioration of groundwater quantity, groundwater flow dynamics, or impacts on groundwater-dependent receptors. The assessment considers the balance between recharge and abstraction, observed or inferred groundwater-level trends, reductions in spring discharge, alteration of groundwater contributions to rivers and wetlands, and the potential for saline intrusion in hydraulically sensitive coastal aquifers.

Special attention is paid to groundwater bodies when abstraction pressures coincide with:

- intensive seasonal irrigation demand,
- public water supply abstraction,
- limited recharge capacity,
- mining or industrial water use,
- and strong hydraulic connectivity with rivers, wetlands, springs, or coastal receptors.

Declining groundwater levels may reduce river baseflow support, lower wetland water tables, diminish karst spring discharge, and increase vulnerability to drought conditions during prolonged dry periods. In several groundwater bodies, groundwater-level alteration pressures (code 6.2) occur simultaneously with abstraction pressures (3.1 and 3.2), indicating cumulative quantitative stress.

Quantitative pressures are most significant in lowland, alluvial, and coastal intergranular aquifers, where groundwater is extensively used for public water supply, irrigation, tourism development, and industrial activities. In these systems, cumulative abstraction may alter regional groundwater gradients and increase the risk of local overexploitation, particularly during summer irrigation peaks and prolonged dry periods. Coastal aquifers are additionally vulnerable to saline intrusion where excessive pumping reduces freshwater hydraulic pressure.

Karst and fractured-rock groundwater systems are also sensitive to quantitative alteration because of their rapid hydraulic response, limited storage capacity, and strong dependence of spring discharge on recharge conditions. Intensive abstraction or drought conditions may reduce spring discharge, seasonally dry smaller springs, and reduce ecological support to hydraulically connected surface-water systems.

Based on the updated screening assessment, groundwater bodies where quantitative pressures are considered most significant include:

- GWB001 Pacram–Velipoje;
- GWB041 Lezhe–Manatie;
- GWB043 Velipoja;

- GWB050 Bulqize–Kraste;
- GWB052 Fushe Arrez;
- GWB055 Memelisht–Peshkepi;
- GWB077 Torrovica;
- GWB087 Koplik–Dobraç;
- GWB105 Pogradec–Grabovica;
- GWB114 Melgushe–Dajç–Milot.

Mining-influenced groundwater bodies are additionally exposed to groundwater-level alteration associated with industrial abstraction, dewatering activities, and modified subsurface flow conditions:

- GWB050 Bulqize–Kraste;
- GWB052 Fushe Arrez;
- GWB055 Memelisht–Peshkepi;

The principal quantitative risks identified include:

- seasonal groundwater drawdown;
- reduced spring discharge;
- altered river baseflow conditions;
- increased groundwater-dependent ecosystem vulnerability;
- local aquifer overexploitation;
- and potential saline intrusion in coastal aquifers.

However, the assessment confidence remains generally low to moderate because groundwater-level monitoring, abstraction metering, and long-term quantitative datasets remain limited across many groundwater bodies. Consequently, several groundwater bodies are classified as “Possibly At Risk” under a precautionary approach pending improved quantitative monitoring and hydrogeological investigation.

Chemical Status

Chemical status assessment evaluates whether human activities are causing deterioration of groundwater quality or creating risks to drinking-water resources, connected surface waters, and groundwater-dependent ecosystems. The assessment considers point-source and diffuse pollution pathways, pollutant persistence, aquifer vulnerability, groundwater flow characteristics, and the capacity of groundwater systems to dilute, attenuate, or naturally recover from contamination pressures.

The principal chemical pressures identified across the basin include:

- diffuse agricultural pollution;
- wastewater infiltration from unsewered settlements;
- mining activities and mine drainage;
- contaminated industrial and legacy sites;
- hydrocarbon releases;
- heavy metal contamination;
- industrial activities;
- and irrigation return flows.

Diffuse agricultural pollution represents one of the most spatially extensive pressures, particularly within intensively cultivated lowland aquifers where fertilizer application, livestock activity, and irrigation return flows contribute to nitrate enrichment and elevated nutrient loading. Urban wastewater pressures are also significant where sewerage infrastructure is incomplete, leaking, or absent, allowing untreated or partially treated wastewater to infiltrate shallow groundwater systems.

Mining areas and contaminated sites constitute the most significant localized chemical pressures. Groundwater bodies associated with mining and contaminated-site pressures include:

- GWB024 Çervenak–Çerrave;
- GWB031 Rragam;
- GWB045 Çeremi;
- GWB048 Fushe Lure;
- GWB050 Bulqize–Kraste;

- GWB052 Fushe Arrez;
- GWB055 Memelisht–Peshkepi;
- GWB116 Çervenak–Stopcka.

These groundwater bodies are exposed to elevated risks from:

- acid drainage;
- metal mobilisation;
- sulphate enrichment;
- hydrocarbon contamination;
- and long-term legacy pollution associated with historical mining and industrial activity.

The most vulnerable hydrogeological settings include:

- shallow alluvial aquifers;
- coastal groundwater bodies;
- fractured-rock aquifers;
- and karst recharge systems.

Shallow alluvial aquifers are highly vulnerable due to:

- high permeability,
- limited natural protection,
- shallow groundwater tables,
- and strong hydraulic connection with surface activities.

Fractured and karst aquifers are particularly sensitive because rapid groundwater transport pathways may allow pollutants to bypass natural filtration mechanisms and spread rapidly through the groundwater system with limited attenuation.

Coastal and lowland groundwater bodies including:

- GWB001 Pacram–Velipoje;
- GWB041 Lezhe–Manatie;
- GWB043 Velipoja;
- GWB087 Koplik–Dobraç;
- GWB114 Melgushe–Dajç–Milot;

They remain especially vulnerable due to:

- agricultural and urban pollution pressures;
- unsewered settlements;
- abstraction-related stress;
- tourism-related development;
- and coastal receptor sensitivity, including saline intrusion risk.

Groundwater bodies with the highest combined pressure intensity are:

- GWB024 Çervenak–Çerrave;
- GWB050 Bulqize–Kraste;
- GWB052 Fushe Arrez;
- GWB055 Memelisht–Peshkepi;
- GWB116 Çervenak–Stopcka.

These groundwater bodies are affected by multiple interacting pressures including:

- mining activities;
- contaminated sites;
- diffuse agricultural pollution;
- abstraction pressures;
- industrial activities;
- and groundwater-level alteration.

The interaction between quantitative stress and chemical pollution substantially increases groundwater vulnerability, particularly where vulnerable aquifers coincide with mining areas, intensive land use, historical industrial activity, or concentrated abstraction demand. Groundwater-level alteration may accelerate contaminant migration, modify groundwater–surface water interactions, and reduce dilution capacity within aquifers.

The most likely chemical impacts associated with these combined pressures include:

- elevated metal and sulphate concentrations;
- nitrate contamination;
- increased electrical conductivity and chloride concentrations;
- hydrocarbon contamination;
- and localized deterioration of spring and shallow groundwater quality.

In coastal groundwater systems, declining groundwater levels may additionally increase chloride concentrations through saline intrusion or mobilisation of mineralised groundwater.

Overall, the updated assessment indicates that:

- confirmed “At Risk” groundwater bodies are primarily associated with mining areas, contaminated sites, coastal aquifers, and intensively exploited lowland systems;
- while many mountainous and less-developed groundwater bodies remain classified as “Possibly at Risk” due to limited monitoring evidence and low assessment confidence.

Chemical status confidence remains constrained by:

- limited monitoring frequency;
- incomplete groundwater chemistry datasets;
- insufficient pesticide, PFAS, solvent, and emerging-pollutant analysis;
- incomplete abstraction inventories;
- and limited event-based monitoring for mining and industrial contamination pathways.

The table below shows the groundwater bodies that are identified as most likely to be at risk of failing WFD environmental objectives based on the main pressure types.

Table 52 - Groundwater Bodies Identified as At Risk.

GWB NAME	WATERBODY EU CODE	OVERALL STATUS	REVISED RISK LEVEL	CL	Main Pressure Types	Justification
Pacram-Velipoje	GWB001	4	At Risk	1	Contaminated sites, diffuse pollution, abstraction, groundwater-level alteration	Coastal/alluvial aquifer vulnerable to nitrate pollution, salinisation and abstraction pressure
Rragam	GWB031	4	At Risk	1	Mining, diffuse pollution, abstraction	Mining-related contamination risk and hydrogeological vulnerability
Bajram-Curri	GWB028	4	At Risk	1	Mining, contaminated sites, abstraction	Urban/mining influence with probable metal contamination risk
Lezhe-Manatie	GWB041	4	At Risk	1	Diffuse pollution, abstraction, groundwater-level alteration	Intensively used lowland aquifer exposed to nutrient and quantitative pressures
Velipoja	GWB043	4	At Risk	1	Diffuse pollution, abstraction, groundwater-level alteration	Coastal aquifer exposed to salinisation and tourism-related pressures
Çervenak-Çerrave	GWB024	4	At Risk	1	Mining, contaminated sites, diffuse pollution	Strong mining-related contamination potential
Peshkopi-Shupenze	GWB016	4	At Risk	1	Mining, diffuse pollution, abstraction	Mining legacy and urban influence justify higher risk

GWB NAME	WATERBODY EU CODE	OVERALL STATUS	REVISED RISK LEVEL	CL	Main Pressure Types	Justification
Çeremi	GWB045	4	At Risk	1	Mining, contaminated sites	Potential heavy metal mobilisation from mining activities
Fushe Lure	GWB048	4	At Risk	1	Mining, diffuse pollution	Mining and local abstraction pressures present
Bulqize-Kraste	GWB050	4	At Risk	1	Mining, contaminated sites, abstraction	Major chromium mining area with well-established contamination risk
Fushe Arrez	GWB052	4	At Risk	1	Mining, contaminated sites	Copper mining pressures likely affecting groundwater quality
Memelisht-Peshkepi	GWB055	4	At Risk	1	Mining, contaminated sites, abstraction	Mining and industrial contamination pressures credible
Torrovica	GWB077	4	At Risk	1	Diffuse pollution, abstraction	Lowland agricultural groundwater body vulnerable to nutrient loading
Koplik-Dobraç	GWB087	4	At Risk	1	Diffuse pollution, abstraction	Urban-agricultural pressure corridor near Shkodër
Pogradec-Grabovice	GWB105	4	At Risk	1	Diffuse pollution, abstraction	Lakeshore groundwater vulnerable to tourism and wastewater pressures
Melgushe-Dajç-Milot	GWB114	4	At Risk	1	Diffuse pollution, abstraction, groundwater-level alteration	Intensively exploited lowland aquifer
Çervanak-Stopcka	GWB116	4	At Risk	1	Mining, contaminated sites, abstraction	Mining and contamination pressures strongly indicated

10.7 Summary Status Assessment of Groundwater Bodies

The groundwater assessment for the Drin–Buna River Basin indicates a spatially heterogeneous pressure–impact regime, where groundwater condition is primarily governed by the interaction between aquifer typology, land use intensity, and receptor sensitivity rather than by basin-wide uniform stressors. This results in a pattern of localized degradation risks superimposed on generally stable or insufficiently characterised groundwater conditions.

Fractured aquifers in mining-affected zones exhibit the highest susceptibility to point-source contamination, where legacy mining activities, waste rock deposits and contaminated sites act as persistent sources of metals and sulphates. In these systems, the dominant controlling factor is the high hydraulic connectivity of fracture networks, which facilitates rapid contaminant transport and limits natural attenuation capacity. As a result, even relatively small contaminant sources can generate disproportionate impacts on downgradient springs and abstraction points.

In contrast, lowland intergranular aquifers are predominantly influenced by diffuse pollution processes linked to agricultural intensification and urban expansion. Here, nitrate leaching, pesticide residues, increased chloride concentrations and elevated conductivity reflect cumulative land-use pressures rather than discrete emission points. The slower groundwater flow regime in these formations leads to longer residence times, but also to gradual accumulation of pollutants, making early-stage deterioration difficult to detect without dense monitoring coverage.

Coastal and irrigated aquifer systems are increasingly affected by abstraction-induced pressure gradients, which locally reduce groundwater levels and alter natural flow directions. These changes can intensify salinisation risks, particularly where reduced hydraulic heads promote seawater intrusion or upward migration of deeper mineralised waters. Such processes are often episodic and spatially

confined, but can have long-term implications for drinking-water abstractions and agricultural supply reliability.

Karst aquifer systems represent a distinct hydrogeological risk class due to their highly transmissive conduit networks and strong hydraulic coupling between recharge zones and discharge springs. These systems exhibit very limited natural attenuation capacity, meaning that surface-derived contaminants can rapidly propagate to spring outlets. Consequently, karst springs function as highly sensitive receptors, providing early indication of both chemical and hydrological disturbance.

Across the basin, however, the current evidence base does not support a conclusion of widespread or uniform groundwater deterioration. Observed impacts remain largely spatially discontinuous and closely associated with identifiable pressure hotspots. Nevertheless, the overall confidence in this conclusion is constrained by significant data limitations, including incomplete monitoring coverage, insufficient temporal resolution of groundwater-quality datasets, and weak integration of abstraction records at groundwater-body scale.

This combination of high intrinsic aquifer vulnerability localized but potentially high-intensity pressure sources, and incomplete observational evidence justifies a precautionary classification of several groundwater bodies as “At Risk” or “Possibly at Risk” under WFD-aligned assessment principles. This classification reflects not only observed exceedances or trends, but also structural uncertainty regarding system status.

From a management perspective, the assessment highlights the need to transition from predominantly pressure-based characterisation toward an integrated receptor-oriented monitoring framework. Priority actions should focus on strengthening both spatial and temporal monitoring density, including groundwater-level networks, abstraction metering, and targeted chemical surveillance for key indicators such as nitrates, pesticides, salinity parameters, and mining-related trace metals. Particular emphasis should be placed on spring discharge monitoring as an integrated response indicator for karst and fractured systems.

Finally, the Programme of Measures should be explicitly risk-targeted, prioritising groundwater bodies where pressure overlap, receptor sensitivity, and data uncertainty coincide. This requires structured aggregation and reporting at groundwater-body scale in line with WISE requirements, ensuring that each identified pressure is consistently characterised by its source, pathway, significance, receptor linkage, likely impact type, associated risk class, and confidence level. This structured approach is essential to move from descriptive characterisation toward defensible risk management and prioritised intervention planning within the basin.

In accordance with the EU Groundwater Directive (GWD), status assessment only needs to be carried out for groundwater bodies identified as being at risk and in relation to the receptor and each of the pollutants which contribute to the GWB being so characterized (GWD, Annex III). Groundwater bodies not at risk are automatically classified as being of good status.

As for surface waterbodies, since data quality is central to the status methodology, it is also necessary to report on the ‘confidence level’ (CL) of the status assessment.¹⁰⁰ A low confidence and precision in the data potentially leads to a risk of misclassification, hence the CL gives an indication of the reliability of the status value.

WISE 2016 guidance advises on the following classification to indicate the confidence on the ecological status or potential assigned: ‘0’ = no information; ‘1’ = low confidence; ‘2’ = medium confidence; ‘3’ = high confidence.

The criteria are as follows: Low = no monitoring data, expert judgement only; Medium = some supporting quality element (QE) data; High = good data on 1+ BQE and supporting most relevant QEs.

¹⁰⁰ WISE GIS Guidance 2016 – Schema: SWB; schema element <SWEcologicalConfidence>

Table 53 gives the overall status assessment of all the ground water bodies within the Drin-Buna River basin.

The Pressures Assessment at groundwater body level has been carried out following the enumeration list for 'risk' categories below:

- a. 'Not at Risk': data or expert judgement supports that the groundwater body is very unlikely to be at risk; status can only be 1 or 2.
- b. 'Possibly at Risk': data or expert judgement suggests that the groundwater body is likely to be at risk; status 2 or 3.
- c. 'At Risk': on basis of either PCHEM data or very significant pressures, its certain that the groundwater body is not at Good or even Moderate status. Status must therefore be 4 or 5.
- d. 'Unknown' should be used where there is no data but where significant pressures seem likely. Status could be 2 or 3 or to be 4 or 5 if we have data.

For GWB classified as "at Risk" the main pressures and the physic-chemical parameters (moderate status-3) are taken into consideration, however there is need for further investigation due to low level of confidence and reliability of the available data. Low level of confidence/low data reliability is indicated for all GWBs and further investigations are needed.

Table 53 - Risk, Pressures and Status Assessment for Groundwater bodies (GWB) within the Drin-Buna River Basin.

IDENTIFICATION		PRESSURE ANALYSIS								STATUS ASSESSMENT						RISK ASSESSMENT	
GROUNDWATER BODY NAME	WATERBODY EU CODE	POINT PRESSURE 1	POINT PRESSURE 2	DIFFUSE PRESSURE 1	DIFFUSE PRESSURE 2	ABSTRACTION PRESSURE 1	ABSTRACTION PRESSURE 2	PHYSICAL PRESSURE 1	PHYSICAL PRESSURE 2	QUANT 1[1]	P-CHEM 1[2]	H-MORPH 1[3]	ANNEX X PSS	ANNEX VIII RBSP	OVERALL STATUS	RISK LEVEL	CL
GWB_001_Pacram-Velipoj	GWB001	1.1		2.1, 2.2		3.1	3.2	4.2.3, 4.2.4	6.2	1	3				4	At Risk	2
GWB_003_Dragoc-Grude-Fusha	GWB003			2.1, 2.2		3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_011_Kopliku	GWB011			2.1, 2.2		3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_014_Jubani	GWB014			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_005_Luarzi-Reci	GWB005			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_021_Kacnija	GWB021			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_020_Fushe-Lura	GWB020			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_022_Fushe-Bulqize	GWB022		1.5, 1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	1				2 or 3	Possibly at Risk	1
GWB_031_Rragam	GWB031		1.5	2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				4	At Risk	2
GWB_030_Bradoshnice	GWB030			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_032_Glmaj-Peraj	GWB032			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_042_Gjegjet-Zall_Reç	GWB042			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_028_Bajram-Curri	GWB028		1.5, 1.7		2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	3				4	At Risk	2
GWB_040_Dragusha	GWB040								6.2	1	3				3	Possibly at Risk	1
GWB_039_Hajmel_Rrabosht	GWB039		1.5, 1.6						6.2	2	1				2	Possibly at Risk	1
GWB_041_Lezhe_Manatie	GWB041			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	4.2.6, 6.2	1	3				3	Possibly at Risk	2
GWB_038_Qerreti_Madh	GWB038			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_037_Bardhaj	GWB037			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1

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GROUNDWATER BODY NAME	WATERBODY EU CODE	POINT PRESSURE 1	POINT PRESSURE 2	DIFFUSE PRESSURE 1	DIFFUSE PRESSURE 2	ABSTRACTION PRESSURE 1	ABSTRACTION PRESSURE 2	PHYSICAL PRESSURE 1	PHYSICAL PRESSURE 2	QUANT 1[1]	P-CHEM 1[2]	H-MORPH 1[3]	ANNEX X PSS	ANNEX VIII RBSP	OVERALL STATUS	RISK LEVEL	CL
GWB_033_Theth-Boge-Zagore	GWB033			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_044_Topojan	GWB044			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_043_Velipoja	GWB043			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	2	3				4	At Risk	2
GWB_027_Lekbibaj-Zogaj	GWB027			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_029_Kernaje-Viçidol	GWB029			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_013_Kalis_Fushe-Muhur	GWB013		1.5, 1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	1				2 or 3	Possibly at Risk	1
GWB_006_Ishull-Lezhe	GWB006			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_008_Shengjin	GWB008			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	4.2.6, 6.2	1	1				2 or 3	Possibly at Risk	1
GWB_009_Shengjin	GWB009			2.1, 2.2	2.6	3.1	3.2	4.2.3	4.2.6, 6.2	1	1				2 or 3	Possibly at Risk	1
GWB_002_Dobraç	GWB002			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	2				2 or 3	Possibly at Risk	1
GWB_010_Kamice-Sterbeqi	GWB010			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	2	1				2 or 3	Possibly at Risk	1
GWB_004_Pentar-Pulaj	GWB004			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_015_Baçallek	GWB015			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_012_Selca	GWB012			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_007_Manatia	GWB007			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_036_Oblika	GWB036			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2-3	Possibly at Risk	1
GWB_034_Tamar-Hot	GWB034			2.1, 2.2	2.6	3.1	3.2	4.2.3	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_018_Çaje-Rasdomire-Bellove	GWB018			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_023_Ternove-Trebisht-Gjinovec	GWB023			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_024_Çervenak-Çerrave	GWB024		1.5, 1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	3				4	At Risk	2
GWB_025_Lajthize-Rakicke	GWB025			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1

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GWB_019_Morine-Shishtavec	GWB019			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_035_Ivanaj-Gashaj	GWB035			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_026_Brezhdan-Lishan	GWB026			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_016_Peshkopi-Shupenze	GWB016		1.5	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	3				4	At Risk	2
GWB_017_Silove-Kishavec	GWB017			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_045_Ceremi	GWB045		1.5	2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				4	At Risk	2
GWB_046_Cereni	GWB046			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_047_Poshte Radomires	GWB047			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_048_Fushe Lure	GWB048		1.5	2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				4	At Risk	2
GWB_049_Fushe Bulqize Shytaj	GWB049			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	4.2.6, 6.2	1	1				2 or 3	Possibly at Risk	1
GWB_050_Bulqize-Kraste	GWB050		1.5, 1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	3				4	At Risk	2
GWB_051_Morine-Perrollaj	GWB051			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_052_Fushe Arrez	GWB052		1.5, 1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	3				4	At Risk	2
GWB_053_Dushi	GWB053			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_054_Gjinovex Klenj	GWB054			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_055_Memelisht-Peshkepi	GWB055		1.5, 1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	3				4	At Risk	2
GWB_056_Buzliqeni - Treni	GWB056			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	4.2.6, 6.2	1	2				2 or 3	Possibly at Risk	1
GWB_057_Bardhoc-Bushtrica	GWB057			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_058_Vermoshi	GWB058			2.1, 2.2	2.6	3.1	3.2	4.2.3	6.2	1	3				3	Possibly at Risk	1
GWB_059_Lepusha	GWB059			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_060_Selca - Ivanaj	GWB060			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1

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GWB_061_Theth - Drisht	GWB061			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	2				2 or 3	Possibly at Risk	1
GWB_062_Bradoshnice-Selimaj	GWB062			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_063_Bugjon-Miliska	GWB063			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_064_Serme-Toplan	GWB064			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_065_Ura e Shtrenjt	GWB065			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_066_Koman - Kçira	GWB066			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_067_Cahan-Mamez	GWB067			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_068_Bardhoc_Bushtrice	GWB068			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_069_Gabrica	GWB069			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_070_Arren-Merkurth	GWB070			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_071_Skavice-Lubeshe	GWB071			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_072_Radomire-Kercisht	GWB072			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_073_Ostren-Zabzun	GWB073			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_074_Tushemisht-Tren	GWB074		1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	1				2 or 3	Possibly at Risk	1
GWB_075_Shiroke-Zogaj	GWB075			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_076_Rragam-Mjede	GWB076			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_077_Torrovica	GWB077			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				4	At Risk	2
GWB_078_Mali Rrencit-Shengjin	GWB078			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				2 or 3	Possibly at Risk	1
GWB_079_Kallmet-Manatia	GWB079			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_080_Vermosh	GWB080			2.1, 2.2	2.6	3.1	3.2	4.2.3	6.2	1	3				3	Possibly at Risk	1
GWB_081_Gegaj-Babina	GWB081			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1

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GWB_082_Luzha	GWB082			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_083_Porav_Gojan	GWB083			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	4.2.6, 6.2	1	1				2 or 3	Possibly at Risk	1
GWB_084_Berishe-Krume	GWB084			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_085_Cibuk-Shikaj	GWB085			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_086_Qaf Grad-Gruemire	GWB086			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_087_Koplik-Dobraç	GWB087			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				4	At Risk	2
GWB_088_Buzhale-Kcira	GWB088			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	2				2 or 3	Possibly at Risk	1
GWB_089_Kabashe-Lajthiza	GWB089			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_090_Lumbardhi	GWB090			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	2				2 or 3	Possibly at Risk	1
GWB_091_Morine-Aliaj	GWB091			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_092_Mnelle e Vogel - Ranza	GWB092			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	2				2 or 3	Possibly at Risk	1
GWB_093_Pregj Lure - Bushtrica	GWB093			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_094_Çaja	GWB094			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_095_Vlesha-Vrenjti	GWB095			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_096_Shumbat-Brest i Poshtem	GWB096			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_097_Arras-Fushe Muhur	GWB097			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_098_Ushtenica	GWB098			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_099_Radomire-Trepca	GWB099			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_100_Shqath-Bllaca	GWB100			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_101_Qaf Murre_Kacni	GWB101			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_102_Valikardhe-Cerenec	GWB102			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1

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GWB_103_Kostricani	GWB103			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_104_Çervenaka-Remenji	GWB104			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_105_Pogradec Grabovice	GWB105			2.1, 2.2	2.6	3.1	3.2	4.2.3	4.2.6, 6.2	1	3				4	At Risk	2
GWB_106_Gorica e Madhe	GWB106			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_107_Liqenas_Cerja	GWB107			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_108_Peraj-Lekbibaj	GWB108			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_109_Breg Lumi - Buzhala	GWB109			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_110_Barcolle-Gomsiqe e Eperme	GWB110			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	1				2 or 3	Possibly at Risk	1
GWB_111_Vidhgari-Berdice e Madhe-Suka e Djegur	GWB111			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				2 or 3	Possibly at Risk	1
GWB_112_Kaptall_Vigu	GWB112			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_113_Manati-Hajmel	GWB113		1.5, 1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	1				2 or 3	Possibly at Risk	1
GWB_114_Melgushe-Dajç-Milot	GWB114			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	4.2.6, 6.2	1	3				4	At Risk	2
GWB_115_Cerenec-Stebleva	GWB115			2.1, 2.2	2.6	3.1	3.2	4.2.3, 4.2.4	6.2	1	3				3	Possibly at Risk	1
GWB_116_Çervenak-Stopcka	GWB116		1.7	2.1, 2.2	2.5	3.1	3.2	4.2.3	4.2.6, 6.2	1	3				4	At Risk	2

10.8 Protected Areas Pressures and Status Assessment

The assessment of protected areas within the Drin–Buna basin confirms that, while Albania has established a comprehensive legal and institutional framework broadly aligned with the EU WFD (2000/60/EC), implementation remains uneven. Pressures affecting protected areas are predominantly spatially concentrated and sector-specific, reflecting the interaction between water use, land management practices, infrastructure deficits, and ecosystem sensitivity. A recurring cross-cutting constraint is the incomplete operationalisation of the Protected Areas Register and limited integration of protected area objectives into river basin management and sectoral planning.

10.8.1 Drinking Water Protected Areas

Drinking water protected areas are primarily based on hygienic-sanitary protection zones established around surface water intakes, springs, and groundwater abstraction points. These zones are legally defined under the Water Resources Law (2024) and implemented through Water Supply and Sewerage Utilities in coordination with national authorities.

In the Drin–Bunë Basin, drinking water supply is overwhelmingly groundwater-dependent, with abstraction from springs and shallow wells representing the dominant supply source. Protection zones are generally established around utility-managed sources; however, coverage is incomplete for privately owned wells, where delineation and enforcement are inconsistent or absent.

The principal pressures affecting these areas include:

- localized contamination risks from inadequate sanitation infrastructure and uncontrolled wastewater leakage;
- diffuse agricultural pollution in recharge zones (notably nitrates and microbial contamination risks);
- lack of systematic enforcement of protection zone restrictions in peri-urban expansion areas;
- incomplete integration of protection zones into municipal spatial planning instruments.

A critical systemic issue is the absence of a consolidated and accessible national register of drinking water protection zones. Institutional fragmentation between the RBAO, municipalities, health authorities, and water utilities limits data sharing and weakens the capacity for risk-based protection. Consequently, while most major abstraction points are nominally protected, the effectiveness of protection is variable.

Overall status is assessed as moderately protected but inconsistently implemented, with localized risk hotspots and medium confidence due to data gaps.

10.8.2 Areas for Protection of Economically Significant Aquatic Species

Protected fisheries areas are regulated under Law No. 64/2012 on Fisheries, including permanent closures, seasonal bans, co-management zones, and gear restrictions. The Drin–Bunë system includes three formally designated co-management fisheries zones: Shkodër Lake and Buna River, Ohrid Lake, and Prespa Lakes.

These systems are ecologically significant, supporting both biodiversity and local livelihoods. However, pressure patterns remain pronounced and include:

- overfishing risks in nearshore and lacustrine systems due to enforcement limitations;
- habitat disturbance in spawning and nursery areas;
- sediment and nutrient loading affecting aquatic habitat quality (particularly in tributary inflows);
- insufficient control of illegal, unreported and unregulated (IUU) fishing activities in some zones;
- lack of operational delineation of additional sensitive or temporary closure areas in parts of the basin.

While the co-management framework provides a strong institutional basis, implementation capacity varies across regions and is constrained by limited monitoring, enforcement resources, and incomplete spatial designation of all fisheries protection categories.

The overall status is assessed as partially effective protection with moderate ecological pressure, and medium confidence due to incomplete spatial data and enforcement variability.

10.8.3 Bathing Waters

Bathing waters are formally designated annually through Council of Ministers decisions, with key sites in the Drin–Bunë Basin including Shëngjin, Rana e Hedhun, Baks-Rrjoli, and Velipojë, and in the Seman Basin Divjakë–Pirgu and Seman beaches.

Despite formal designation, the bathing water monitoring system remains limited in spatial coverage and methodological consistency. Pressures affecting these areas include:

- untreated or partially treated urban wastewater discharges in coastal catchments;
- seasonal tourism-driven increases in pollution loads;
- river-borne nutrient and microbial contamination from upstream basins;
- insufficient monitoring density and lack of continuous compliance assessment aligned with EU Bathing Water Directive standards.

Available monitoring data indicate a declining trend in water quality in key northern coastal areas, particularly Velipojë and Shëngjin, where reductions in “excellent” classifications and increases in “sufficient” and “poor” categories have been observed. This suggests emerging eutrophication and microbial risk pressures linked to both urban and riverine inputs.

The overall status of bathing waters is assessed as moderately to poorly protected depending on site, with declining quality trends in some areas, and moderate confidence due to limited monitoring coverage.

10.8.4 Nutrient-Sensitive Zones

Nutrient-sensitive areas, including Nitrate Vulnerable Zones and sensitive areas under the Urban Wastewater Treatment Directive, have not yet been formally designated in the Drin–Bunë Basin. This represents a significant gap in WFD implementation.

Current monitoring data show generally low nutrient concentrations across most stations in the Drin system, with nitrite and nitrate values remaining within high-status classes. However, this basin-wide picture masks localized pressures, particularly:

- agricultural runoff in lowland intensification zones;
- urban wastewater discharges in peri-urban areas;
- nutrient enrichment in downstream and coastal transitional waters;
- emerging eutrophication risk in sensitive lake and delta systems.

In the absence of formal designation, nutrient-sensitive areas are not yet subject to targeted regulatory controls or management measures, limiting preventive action capacity.

The overall status is assessed as not yet operationalised under WFD requirements, with low institutional implementation despite currently acceptable measured concentrations, and medium confidence due to absence of formal zoning and incomplete causal attribution.

10.8.5 Nature Protection Areas

Nature protection areas represent the most developed component of the protected areas system in Albania, including national parks, managed nature reserves, protected landscapes, Ramsar sites, Emerald Network sites, and internationally designated areas (IBAs, KBAs, UNESCO sites).

The Drin–Bunë Basin contains a high density of ecologically significant sites, including Shkodra Lake–Buna River, the Albanian Alps, Shebenik–Jabllanica, and multiple interconnected wetland and mountain ecosystems.

Despite strong legal designation coverage, key pressures remain:

- hydromorphological alteration due to hydropower cascade regulation affecting downstream ecological flows;
- habitat fragmentation linked to infrastructure development and tourism expansion;
- pollution pressures from upstream urban and agricultural sources affecting wetland systems;
- inadequate integration of management plans into RBMP and spatial planning frameworks;
- delays in approval and operationalisation of protected area management plans.

While the designation rate is high (over 20% of national territory), management effectiveness is uneven, with several areas operating under draft or outdated management plans.

The overall status is assessed as legally well-covered, but management-effectiveness constrained, with moderate ecological pressure and medium confidence due to implementation gaps rather than designation deficits..

10.8.6 Summary Status Assessment of Protected Areas

Across all protected area categories, the assessment highlights a clear divergence between legal designation strength and implementation effectiveness. Albania has established a comprehensive legislative framework aligned with WFD Annex IV requirements and has achieved extensive spatial coverage of protected areas. However, operational effectiveness is constrained by fragmented institutional coordination, incomplete registers, and uneven monitoring capacity.

Key cross-cutting findings include:

- Protected areas are generally well designated but inconsistently managed;
- The Protected Areas Register is not fully operational or publicly accessible, limiting transparency and integration;
- Monitoring systems are uneven and insufficiently aligned with WFD requirements, particularly for bathing waters and nutrient-sensitive zones;
- Pressures are predominantly localized but cumulative, especially in coastal, lowland agricultural, and urban-influenced systems;
- Management effectiveness is highest in formally established conservation areas but weakest in water-quality related protected categories (drinking water, nutrients, bathing waters);
- There is a consistent need to improve data integration, inter-institutional coordination, and GIS-based spatial consolidation.

Overall, protected areas in the Drin–Buna basin can be characterised as highly advanced in designation but only partially effective in achieving intended water protection outcomes, with system performance limited primarily by implementation and governance constraints rather than legislative gaps.

10.9 Discussion and way forward

The assessment confirms that the Drin–Bunë River Basin is characterised by strong interlinkages between hydropower regulation, land use change, urban wastewater discharge, agricultural runoff, and mining-related pressures. These pressures are not isolated but cumulative, reinforcing each other across the river–lake–delta continuum and resulting in widespread ecological vulnerability.

Hydromorphological alteration remains the dominant structural pressure, particularly due to the hydropower cascade, which affects flow regimes, sediment transport, and ecological connectivity. This is compounded

by diffuse nutrient pollution from agriculture and insufficient wastewater treatment in urban and peri-urban areas, which together drive eutrophication risks in lakes, transitional waters, and coastal zones.

Groundwater systems exhibit generally localized but significant risks, especially in lowland alluvial and mining-affected aquifers, where abstraction pressures and contamination pathways overlap. However, the lack of systematic monitoring limits the ability to fully quantify trends, reinforcing the need for a more robust groundwater observation and abstraction control framework.

Protected areas are widely designated but inconsistently effective in achieving their water protection objectives. Key weaknesses lie in implementation, enforcement, and integration into river basin planning, particularly for drinking water protection zones, bathing waters, and nutrient-sensitive areas.

Going forward, the most critical priority is to transition from a predominantly descriptive and pressure-based assessment approach to a fully operational, evidence-driven management system. This requires strengthening the monitoring network (biological, chemical, hydrological, and groundwater), improving data integration through centralized GIS-based systems, and ensuring consistent WISE-aligned reporting across all water categories.

Equally important is the implementation of targeted Programme of Measures that address the most significant pressure clusters: hydro morphological restoration and ecological flow management in regulated rivers; expansion and upgrading of wastewater treatment infrastructure; reduction of agricultural diffuse pollution through best management practices; and strengthened control of abstraction in vulnerable aquifers.

Finally, achieving WFD objectives will depend on improved institutional coordination and sustained investment, including enhanced transboundary cooperation for shared water bodies. Without these reforms, the basin is likely to remain in a state of partial compliance, with many water bodies continuing to be classified as “At Risk” or “Possibly at Risk” over successive planning cycles.

11 Economic Analysis of Water Uses, Revenue Analysis and Cost Recovery

Prepared in accordance with Article 5 and Annex III of the WFD, this chapter examines the economic significance of water uses in the Drin-Buna Basin. It provides an overview of key sectors (agriculture, energy, tourism, domestic water supply), analyses water service costs and revenues and assesses cost recovery levels for each service. The section also explores economic trends influencing future water demand and highlights where financial instruments and pricing policies can improve efficiency and sustainability. Recommendations support the principle of cost recovery and the ‘polluter pays’ approach.

Additional background, technical information, and data are presented in the Task Report 8.

11.1 Introduction to the Economic Analysis under the Water Framework Directive

The economic analysis presented in this chapter has been prepared in accordance with the requirements of Article 5 and Annex III of the EU WFD, which require Member States and candidate countries to assess the economic significance of water uses and water services within each river basin district. The objective of the analysis is to provide an economic baseline for the RBMP and to support the identification of measures that are environmentally effective, economically justified and financially feasible.

Economic analysis forms an integral part of integrated river basin management. Beyond describing how water is used, it helps explain the relationship between water resources and economic development, identifies the sectors that depend on water, evaluates the performance of water services and supports decisions regarding investments, cost recovery and the prioritisation of measures. It also contributes to the implementation of key WFD principles, including the polluter-pays principle, the user-pays principle, and the requirement to promote the efficient and sustainable use of water resources.

For the Drin-Buna River Basin, the analysis considers the principal water-dependent sectors, including public water supply and sanitation, agriculture, livestock production, industry, hydropower generation, fisheries, aquaculture and tourism. Particular attention is given to sectors that generate significant water abstractions, influence water quality or depend directly on the availability of water resources for their economic performance.

In line with the WFD methodology, the assessment combines information on current water uses with projections of future demand, evaluates the structure and performance of water services and reviews the extent to which the costs of these services are recovered through tariffs, public funding and other financing mechanisms. While the primary focus is on financial cost recovery, broader economic considerations relevant to sustainable water resources management are also taken into account.

As is common for many river basin districts, detailed economic statistics are not always available at basin level. Consequently, the analysis combines national and regional datasets with sector-specific information and, where appropriate, uses proportional allocation methods and proxy indicators to derive basin-level estimates. The results should therefore be regarded as indicative values intended to support strategic planning rather than detailed economic accounting.

The findings presented in this chapter provide an important analytical basis for the development of the Programme of Measures and contribute to ensuring that future investments and policy decisions support

both the environmental objectives of the WFD and the long-term socio-economic development of the Drin–Buna River Basin.

11.2 The Drin–Buna River Basin: Economic Baseline and the Importance of Water Use

11.2.1 General socio-economic indicators

The Drin–Buna River Basin is one of Albania's most strategically important river basins, both in terms of its natural resources and its contribution to the national economy. Extending across northern Albania and forming part of a larger transboundary river system shared with Montenegro, Kosovo, North Macedonia and Greece. The basin supports a wide range of economic activities that depend directly or indirectly on reliable water resources.

The basin is characterised by considerable geographical diversity, ranging from mountainous catchments in the north and northeast to productive agricultural areas, internationally important lakes and rapidly developing urban centres. This diversity has shaped an equally varied economic structure in which agriculture, hydropower, public water supply, fisheries, tourism, manufacturing and ecosystem services all play significant roles.

Unlike several other Albanian river basins, the Drin–Buna Basin occupies a unique position within the national economy because it contains Albania's largest hydropower cascade while simultaneously supporting extensive irrigated agriculture, rural livelihoods and internationally recognised freshwater ecosystems. Water therefore represents not only an environmental resource but also a strategic economic asset that underpins regional development, employment, energy security and climate resilience.

Although comprehensive economic statistics are generally compiled at county rather than river basin level, available regional indicators demonstrate the substantial contribution of the basin to agricultural production, renewable energy generation and public water supply. Maintaining the quantity and quality of available water resources is therefore essential for sustaining future economic growth and achieving the environmental objectives established under the River Basin Management Plan.

11.2.2 Population, urban–rural structure and households

The Drin–Buna River Basin has a predominantly rural population structure, reflecting the extensive mountainous landscapes and agricultural areas that characterise much of northern Albania. The principal urban centres include Shkodër, Lezhë, Kukës, Dibër and Pogradec, while a large proportion of the population lives in smaller municipalities and dispersed rural settlements.

According to the latest basin assessment, approximately 423,000 inhabitants lived within the Albanian part of the basin in 2024. Around 43% of the population resides in urban areas, while approximately 57% lives in rural communities, making the Drin–Buna Basin considerably more rural than many other parts of the country. This settlement pattern has important implications for water supply infrastructure, wastewater collection, service costs and future investment requirements.

Demographic trends largely follow national patterns. Population decline, ageing and migration towards larger urban centres continue to reshape the distribution of households across the basin, particularly in remote mountainous municipalities. Population projections indicate that these trends are likely to continue over the coming decades, reducing demand in some rural areas while increasing the importance of maintaining efficient and financially sustainable water services despite a declining customer base.

At the same time, seasonal tourism around Lake Shkodër, Lake Ohrid, the Buna River and the Albanian Alps creates temporary increases in water demand during the summer months, placing additional pressure

on local water supply systems and wastewater infrastructure. These seasonal fluctuations need to be considered when planning future investments in water services.

11.2.3 Workforce and employment

Employment within the Drin–Buna River Basin reflects its predominantly rural economy and the strong dependence of local communities on natural resources. Agriculture continues to provide a significant share of total employment, particularly in the municipalities of Shkodër, Kukës, Dibër and Lezhë, where crop production, livestock farming, fisheries and forestry remain important sources of income.

At the same time, the basin plays a nationally important role in renewable energy production through the Drin hydropower cascade, while manufacturing, food processing, construction materials, trade, tourism and public services provide additional employment opportunities in the main urban centres. The gradual expansion of the service sector has contributed to increasing economic diversification, although agriculture continues to account for a higher share of employment than the national average.

The availability of reliable water resources directly influences the productivity and competitiveness of many of these sectors. Consequently, future changes in employment patterns, demographic development and economic diversification are expected to influence both the volume and spatial distribution of water demand across the basin.

11.2.4 Socio-economic analysis of water users

Water resources underpin virtually every major economic activity within the Drin–Buna River Basin. Although the intensity of water use varies considerably between sectors, reliable access to good-quality water remains essential for sustaining economic growth, protecting ecosystems and supporting local livelihoods.

11.2.5 Agriculture and livestock

Agriculture is the largest consumptive water user in the basin and represents one of the principal drivers of rural economic development. Irrigation supports crop production across approximately 95,000 hectares of cultivated land, while livestock farming depends on reliable water supplies throughout the year. Continued improvements in irrigation efficiency offer the greatest opportunity for reducing pressure on available water resources while maintaining agricultural productivity.

11.2.6 Public water supply

Drinking water services provide essential support for households, businesses, tourism facilities and public institutions. Although service coverage has improved over recent years, further investments in leakage reduction, network rehabilitation and operational efficiency remain necessary to ensure reliable and financially sustainable service provision.

11.2.7 Industry

Industrial abstractions are estimated at approximately 12 million m³/year, with food processing, construction materials, wood processing, mining-related activities and small manufacturing representing the principal industrial water users, with both public supply systems and self-abstraction from groundwater serving industrial users.

11.2.8 Hydropower

Hydropower is the basin's most significant non-consumptive water use and represents one of the defining features of the Drin–Buna River Basin. The Drin cascade contributes substantially to Albania's electricity generation and energy security while also influencing river flow regimes and water management throughout the basin. Although hydropower does not consume water in the conventional sense, reservoir operation has important implications for ecosystem functioning, downstream flows and flood management.

11.2.9 Fisheries, aquaculture and tourism

The basin's lakes, rivers and wetlands support commercial fisheries, aquaculture and a rapidly growing tourism sector centred on Lake Shkodër, Lake Ohrid, the Buna River and the Albanian Alps. These activities depend directly on maintaining good ecological status and high water quality, reinforcing the close relationship between environmental protection and sustainable economic development.

Aquaculture represents an important water-dependent sector within the basin, requiring approximately 55 million m³/year of water under current conditions. Most of this water is returned to the receiving environment after use, although adequate water quantity and quality remain essential for fish production.

Overall, the economic future of the Drin–Buna River Basin will remain closely linked to the sustainable management of its water resources. Improving the efficiency of water services, protecting aquatic ecosystems and strengthening institutional cooperation will be essential for balancing economic development with the long-term objectives of the WFD.

11.3 Current and Future Water Use and Relevant Developments

The Drin–Buna River Basin supports a wide range of water-dependent economic activities and provides one of Albania's most important water resource systems. Water resources underpin public water supply, irrigated agriculture, livestock production, aquaculture, industry, tourism and hydropower generation, while also sustaining internationally important freshwater ecosystems and wetlands. The basin's transboundary character further increases the importance of coordinated and sustainable water resources management. Hydropower dominates overall water use in volumetric terms, with approximately 11,000 million m³ of water passing annually through the Drin hydropower cascade. Since this water is returned to the river system after electricity generation, hydropower is classified as a non-consumptive water use. Among consumptive water uses, irrigation represents by far the largest abstraction, followed by public water supply, aquaculture, industrial activities and livestock production. This distribution illustrates the dual role of the basin as both Albania's principal hydropower system and one of its most important agricultural production areas.

Current water use reflects the predominantly rural character of the basin and the importance of agricultural production. Among consumptive water uses, irrigation represents by far the largest water demand, with approximately 52,255 ha currently irrigated and an estimated annual abstraction of 399.7 million m³. Public water supply is the second largest managed water service, with annual water production of approximately 43.6 million m³, although only around 23.3 million m³ reaches final consumers due to significant levels of non-revenue water. Livestock production accounts for approximately 3.1 million m³/year, while industrial water use remains relatively limited compared with agricultural abstractions. Aquaculture also represents an important water-dependent activity within the basin, requiring substantial water flows while largely returning water to the receiving environment. Hydropower generation, although the most significant water-related economic activity in the basin, is considered a non-consumptive use because water remains within the river system after energy production.

Future water demand in the Drin–Buna River Basin will be shaped by a combination of demographic, economic, environmental and institutional factors. While population projections indicate relatively stable or gradually declining domestic demand in several municipalities, increasing climate variability, continued agricultural development and improvements in irrigation infrastructure are expected to become the main drivers of future water use.

Under the baseline (Business-as-Usual) scenario, irrigation demand is projected to increase from approximately 400 million m³/year in 2025 to around 532 million m³/year by 2040. This increase reflects the planned expansion of irrigated land, higher irrigation requirements during longer and more frequent dry periods, and the continued importance of agriculture for rural development and food security. At the same time, public water supply is projected to increase moderately, with annual water production rising from approximately 43.6 million m³ to 52.5 million m³, primarily as a result of improvements in service coverage

and operational performance rather than significant population growth. Industrial water demand, livestock production and aquaculture are also expected to increase gradually in line with projected economic development, although their contribution to total consumptive water use will remain comparatively modest. The implementation of efficiency measures substantially changes this outlook. Planned rehabilitation of irrigation systems, improved water allocation, modern irrigation technologies, leakage reduction programmes, pressure management and wider metering coverage are expected to reduce abstraction pressures while maintaining or even increasing the level of service provided. Under the water efficiency scenario, utilities are expected to significantly reduce non-revenue water, lowering distribution losses from approximately 46% in 2025 to around 14% by 2040. Similar improvements in irrigation efficiency are expected to reduce water losses throughout the irrigation network and improve overall water productivity without compromising agricultural production.

Hydropower generation is expected to remain the dominant water-related economic activity throughout the planning period. Although the volume of water passing through the Drin hydropower cascade is substantially larger than all other water uses combined, hydropower is considered a non-consumptive use because water is returned to the river system after electricity generation. Future hydropower production is therefore expected to depend primarily on hydrological conditions and climate variability rather than on increasing water abstractions. Maintaining an appropriate balance between energy production, ecological flows, downstream water uses and ecosystem protection will remain one of the key challenges for integrated water resources management in the basin.

Overall, future water management in the Drin–Buna River Basin will increasingly focus on improving water-use efficiency rather than expanding abstractions. Investments in modern infrastructure, improved operational management, climate adaptation measures and strengthened institutional cooperation will be essential to accommodate future water demand while safeguarding the ecological status of rivers, lakes and groundwater bodies in accordance with the objectives of the WFD.

11.4 Water Services

Water services within the Drin–Buna River Basin comprise public water supply and sanitation, irrigation and drainage, industrial water supply, as well as supporting services related to hydropower generation and other water-dependent economic activities. Together, these services form the backbone of the basin's socio-economic development while contributing to public health, food production, renewable energy generation and environmental protection.

Water services are currently undergoing regionalisation following the national water sector reform, with utilities progressively expanding their service areas and harmonising operational standards, asset management and tariff structures.

Public water supply is based predominantly on groundwater resources, including springs and aquifers that provide high-quality raw water for most municipalities. Water supply and wastewater services are delivered by regional water utilities operating under the national utility consolidation programme. Although considerable progress has been achieved through institutional reforms and infrastructure investments, many utilities continue to experience operational challenges associated with ageing infrastructure, intermittent water supply, high levels of non-revenue water and incomplete wastewater collection and treatment systems. Current network losses remain close to 46%, highlighting the considerable potential for improving operational efficiency through rehabilitation and leakage reduction programmes.

Irrigation services represent the largest consumptive water service within the basin and are supported by an extensive network of reservoirs, diversion structures, canals, pumping stations and drainage systems. While this infrastructure provides the basis for agricultural production across the basin, further rehabilitation and modernization remain essential to improve conveyance efficiency, reduce water losses and strengthen resilience to climate change.

Industrial water services rely on both municipal supply systems and direct abstractions from groundwater sources, depending on operational requirements. Although industrial demand is relatively modest, continued improvements in industrial water efficiency and wastewater management will contribute to reducing local environmental pressures.

Given the strategic importance of the Drin hydropower cascade and the transboundary nature of the basin, effective water services also require close coordination between water utilities, irrigation authorities, river basin institutions and neighbouring countries to ensure sustainable allocation and protection of shared water resources.

11.5 Cost, Revenue and Cost Recovery Analysis

The assessment of cost recovery has been carried out in accordance with Article 9 of the WFD, which requires Member States and candidate countries to take account of the principle of recovering the costs of water services, including financial, environmental and resource costs, while considering the polluter-pays principle as well as social, environmental and economic impacts.

For the Drin–Buna River Basin, the analysis focuses primarily on public water supply and wastewater services, for which the most comprehensive financial and operational information is available. The assessment considers the relationship between operating costs, revenues generated through water tariffs, investment financing and the overall financial sustainability of water service providers. In addition, it reviews the current tariff framework and the extent to which existing financing mechanisms support the long-term provision of water services.

Water tariffs in Albania are regulated by the Water Regulatory Authority (ERRU), which approves tariff levels based on utilities' operational costs, investment needs, service quality objectives and affordability considerations. During recent years, regulatory reforms and the regionalisation of water utilities have contributed to a more transparent and consistent tariff-setting framework. Nevertheless, the economic analysis indicates that existing tariff levels generally enable utilities to recover a substantial share of their operating and maintenance costs, while major capital investments, network rehabilitation and system expansion continue to depend largely on state budget allocations and financial support from international financial institutions and development partners. Consequently, full financial cost recovery, as envisaged under Article 9 of the WFD, has not yet been achieved across the basin.

The analysis also highlights that the financial performance of water utilities continues to be affected by several structural challenges. High levels of non-revenue water, ageing infrastructure, incomplete wastewater collection and treatment systems, and operational inefficiencies reduce the ability of utilities to generate sufficient revenues for future investments. Although billing and collection performance has improved in many service areas, further progress is required to strengthen the long-term financial sustainability of water services throughout the basin.

Improving cost recovery will therefore require a combination of regulatory, technical and operational measures rather than tariff adjustments alone. Priority actions include reducing physical and commercial water losses, expanding metering coverage, improving billing and collection efficiency, strengthening asset management and optimising operational expenditure. Continued rehabilitation of water supply and wastewater infrastructure, supported by appropriate investment planning, will further improve utility performance while limiting future financing needs.

From a river basin management perspective, cost recovery should be viewed not only as a financial objective but also as an instrument for promoting the efficient and sustainable use of water resources. Appropriate tariff policies, combined with improved operational performance and targeted public investment, can strengthen the financial resilience of water service providers while maintaining affordable access to essential water services. Over time, progressive improvements in cost recovery will contribute to

more sustainable financing of water infrastructure, better environmental performance and the achievement of the objectives established under the WFD.

11.6 Main Conclusions and Recommendations

The economic analysis confirms that water resources are among the most valuable strategic assets of the Drin–Buna River Basin, supporting a broad range of economic activities while sustaining internationally important freshwater ecosystems. The basin performs a unique role within Albania by simultaneously supporting the country's largest hydropower system, extensive irrigated agriculture, public water supply, fisheries, aquaculture, tourism and other water-dependent sectors.

Among consumptive water uses, irrigation represents by far the largest abstraction, while public water supply, aquaculture, industrial activities and livestock production account for comparatively smaller shares of total water demand. Hydropower remains the dominant water-related economic activity in volumetric terms, although it is considered a non-consumptive use because water is returned to the river system after electricity generation. Future water management will therefore need to balance agricultural development, reliable public water services, renewable energy production and the protection of aquatic ecosystems.

Although important progress has been achieved through institutional reforms and investments in water infrastructure, significant challenges remain. High levels of non-revenue water, ageing infrastructure, incomplete wastewater collection and treatment, and continued dependence on external financing continue to constrain the operational and financial performance of water services. Strengthening cost recovery, improving operational efficiency and reducing water losses will therefore remain essential for ensuring the long-term sustainability of the sector.

Looking ahead, climate change, increasing irrigation requirements, seasonal tourism and changing hydrological conditions are expected to place additional pressure on available water resources. Rather than relying on increased abstractions, future water management should focus on improving water-use efficiency through rehabilitation of irrigation systems, reduction of non-revenue water, modernisation of water supply infrastructure and the wider application of water-saving technologies.

Given the transboundary nature of the Drin–Buna River Basin, continued cooperation between Albania and neighbouring countries will remain fundamental for achieving the objectives of the WFD. Integrated planning, strengthened monitoring systems, protection of groundwater and surface water bodies, and coordinated management of ecological flows will be essential for maintaining both the environmental status of the basin and the long-term socio-economic benefits derived from its water resources.

Overall, the economic analysis demonstrates that improving the efficiency, resilience and financial sustainability of water services represents the most cost-effective pathway for supporting sustainable development while ensuring the long-term protection of the Drin–Buna River Basin.

12 PROGRAMME OF MEASURES FOR THE DRIN-BUNA BASIN

This chapter sets out the Programme of Measures required to progressively achieve the Drin-Buna basin's environmental objectives. It explains the rationale and prioritisation of measures, distinguishing between basic and supplementary measures in line with Articles 11 and 12 of the WFD. It integrates Albania's recent Directive Specific Implementation Plans (DSIPs), details implementation timelines, responsible authorities, indicative costs, and potential funding sources. The PoM covers interventions for both surface and groundwater and integrates cross-sectoral actions.

Additional background, technical information, and data are presented in the Task Report 7.

13 Summary of the Register of Protected Areas in the Drin-Buna River Basin

This chapter presents a summary of the register of protected areas as required by Article 6 and Annex IV of the WFD. It identifies the types of protected zones within the basin, including drinking water abstraction areas, economically significant aquatic ecosystems, and areas designated for nature protection or recreation.

Additional background, technical information, and data are presented in the Task Report 2.

13.1 Need and Purpose of a Register of Protected Areas

The Register of Protected Areas is a core requirement for implementing the EU WFD. Under WFD Article 6 and Annex IV, competent authorities must identify all areas within a River Basin that require special protection for surface water, groundwater, or water-dependent habitats and species. The register creates the formal link between river basin management planning and the specific objectives set under other EU water, nature, health, and pollution-control legislation.

The register is necessary because protected areas often require objectives that go beyond the general WFD objective of achieving good status. Drinking Water Protected Areas, bathing waters, nutrient-sensitive areas, fisheries areas, and water-dependent nature conservation sites all have specific protection needs. By including these areas in one basin-wide register, the RBMP can clearly identify where stricter standards, targeted monitoring, or additional measures are required.

The register also supports transparent and accountable decision-making. It shows where protected areas are located, which water bodies they overlap with, which legislation applies, and which authority is responsible for protection and management. This enables competent authorities to integrate protected area requirements into monitoring programmes, status assessment, pressure analysis, and the Programme of Measures.

For Albania, establishing a Register of Protected Areas is particularly important for aligning river basin management with the EU acquis and for strengthening implementation under Law No. 29/2024 on Water Resources. It helps close current gaps in mapping, monitoring and enforcement, especially for drinking water sources, bathing waters, nutrient-sensitive areas, and water-dependent ecosystems. A complete and regularly updated register ensures that protected area objectives are not treated separately from the RBMP but become an integral part of achieving WFD-compliant water management.

Protected areas in the Drin-Buna River Basin are regulated under Law No. 29/2024 on Water Resources and align with WFD Article 6 and Annex IV. They encompass zones for water supply protection, fisheries, nature conservation, and other areas of special ecological or socio-economic value. Task Report 2 contains the full Register of Protected Areas, also summarized in Chapter 13.

Their designation and management ensure the alignment of Albania's river basin planning with EU water and biodiversity policies. The register includes five categories as follows:

- Drinking water abstraction zones
- Areas designated for the protection of economically significant aquatic species
- Recreational (bathing) waters
- Nutrient-sensitive zones (e.g. nitrate vulnerable zones)
- Natura 2000 sites and nationally designated nature protection areas

13.2 Register of protected areas of the Drin-Buna River Basin

Drinking Water Abstraction Zones

The basin is a critical source of drinking water for Shkodër, Kukës, and Lezhë, with most water derived from groundwater springs and wells. According to data from the local water utility, some sources have designated protection perimeters (measured in meters) around the abstraction points. However, in practice, the infrastructure and enforcement to secure these zones is often missing or inadequate. Information on these protection areas is not yet included in a consolidated register, and systematic mapping is lacking. As a result, while some protection measures exist on paper, their effectiveness in safeguarding water sources remains uncertain. Private wells, widely used in rural areas, remain outside the formal system. Drinking water zones are meant to guarantee clean supply for human consumption, which directly supports the WFD objective of good chemical status. Without reliable mapping, monitoring, and effective protection infrastructure, these sources remain vulnerable to pollution.

Areas for Protection of Economically Significant Aquatic Species

The Drin-Buna basin contains some of Albania's most ecologically and economically valuable fisheries resources. Three co-managed fisheries zones are designated as follows¹⁰¹ (**Error! Reference source not found.**):

- Lake Shkodra and Buna River (DCM 469/2016) – the largest lake in the Balkans, a Ramsar site, and a critical wetland for fish spawning and migratory birds. Traditional fishing is allowed under strict rules.
- Ohrid Lake (DCM 283/2016) – a UNESCO site with high endemism and long-standing fisheries.
- Prespa Lakes (DCM 734/2017) – important for transboundary fisheries and biodiversity.

These zones operate through local fisheries organisations, under co-management plans that regulate fishing methods, vessel use, and catch limits, with the aim of sustainable exploitation and ecosystem balance, thus contributing to the WFD's ecological objectives.

Co-management plans for these areas are approved by MARD and must also align with the Drin-Buna Basin Management Plan. All fishing activities and related investments must comply with these obligations, while Fisheries Management Organisations are responsible for regulating fishing boat placement and use. At present, there is no information available on restricted or fully protected fishing areas in the basin, which highlights the need for improved monitoring, transparency, and reporting to ensure fish stock sustainability.

Recreational (Bathing) Waters

Bathing waters are formally designated each year through a Decision of the Council of Ministers (DCM), which approves the list of permitted beaches and their typologies. Within this basin, Shëngjin, Rana e Hedhun, Baks Rrjollë, Velipojë, are included as official bathing waters. Despite this legal framework, monitoring remains limited. Albania has not yet established a comprehensive programme fully aligned with the EU Bathing Water Directive, and the impact of urban discharges on coastal water quality has been assessed only for Durrës, Vlorë, and Sarandë, leaving the Drin-Buna coast largely unexamined. According to the 2023 State of the Environment Report, In Velipojë, monitoring showed one station with excellent quality, one sufficient, and the rest good. Compared with previous years, the share of excellent sites has decreased, while good and sufficient categories have increased, indicating a gradual decline in water quality, though no poor-quality stations were recorded.

In Shëngjin, the situation deteriorated sharply. No stations achieved excellent quality in 2023; instead, most fell into poor or sufficient categories. This marks a clear shift from excellent conditions in 2022 to predominantly poor quality in 2023, signalling a worrying decline in bathing water quality. Overall, the low number of monitoring sites and lack of systematic public reporting means that environmental objectives for

¹⁰¹ <https://www.fao.org/faolex/results/details/en/c/LEX-FAOC163407>

safe recreation and protection of public health are not being met. As a result, alignment with the WFD requirement to safeguard water bodies used for human purposes remains incomplete, particularly in areas where tourism and recreation are most significant.

Nutrient-Sensitive Zones

No nitrate vulnerable zones or sensitive wastewater areas have yet been designated in the Drin-Buna basin, even though the Water Resources Law provides for them. Monitoring data from 2023¹⁰² show nitrate levels ranging from 0.083–0.61 mg/l, which fall within Class I-High Status. This means that, for now, the waters at the monitoring sites, are not affected by nutrient pollution, and the environmental objective of avoiding eutrophication is being met in practice.

However, because nutrient-sensitive zones have not been officially declared, the specific preventive measures that normally apply in such areas under EU law-like stricter wastewater treatment requirements or Codes of Good Agricultural Practice for farmers, are not yet in place. This creates a gap between the current good status and long-term protection, since agriculture in the basin could expand or intensify in the future. Designating these zones would therefore be essential for aligning with the WFD's "no deterioration" principle, ensuring that water quality is protected not only under current conditions but also against future risks from agricultural pollution and nutrient enrichment.

Nature Protection Areas (Habitats and Species)

The basin hosts a wide network of nationally and internationally protected areas: national parks (e.g., Alpet e Shqipërisë, Lurë–Mali i Dejës, Shebenik), nature reserves (Liqeni i Shkodrës, Kune-Vain), protected landscapes (Buna-Velipojë, Liqeni i Pogradecit), as well as Ramsar wetlands, Emerald sites, Important Bird Areas, and UNESCO World Heritage sites (**Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**). These sites safeguard wetlands, rivers, lakes, forests, and mountain ecosystems, many of which are directly water dependent.

They aim to conserve biodiversity and protect habitats and species of European importance, which directly ties to the WFD's objective of good ecological status. Despite the existence of draft management plans for some protected areas, many remain unapproved and lack formal adoption, limiting their effectiveness in guiding conservation efforts. More critically, protected area management plans are not fully integrated into territorial development and river basin management plans, leading to fragmented planning and missed opportunities for sustainable resource management. Weak enforcement further reduces their capacity to address threats effectively.

Table 54 - Areas of co-management in Drini-Buna River Basin.

No.	Water Body/Area	Decision of the Council of Ministers
1	Shkoder Lake and Buna River	Decision No. 469, dated 22.06.2016 "On the Designation of Lake Shkodra and the Buna River as a Co-Managed Fisheries areas"
2	Ohrid Lake	Decision No.283, dated 13.4.2016 "on the designation of Ohrid Lake as a Co-managed Fishery Zone"
3	Prespa Lake	Decision No. 734, dated 08.12.2017 "On the Designation of Prespa Lakes as a Co-Management Fishery area"

Table 55 - Overview of protected areas in Albania by management category.

No.	National protected area category	Area (ha)	Protected areas (#)	% of country's territory
II	National Park	315,304	13	10.9
III	Nature Monument		738	
IV	Nature Park	222,134	30	7.7
V	Protected landscape	68,454	5	2.3
VI	Protected area with sustainable use of natural resources	18,245	4	0.63

¹⁰² Environmental Report 2023, NEA.

	TOTAL	624,137	790	21.7
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Table 56 - Overview of protected areas in Drin-Buna River Basin by management category.

National protected area category	Name of the PA	DCM No.	Management plan
National Park	Alpet e Shqipërisë	59, date 26.01.2022	Draft. Not officially approved
	Lurë-Mali i Dejës	59, date 26.01.2022	-
	Shebenik	59, date 26.01.2022	Approved until 2028
Natural Park (Managed Nature Reserve)	Lugina e Shalës	60, date 26.01.2022	-
	Munella	60, date 26.01.2022	-
	Korab-Koritnik	60, date 26.01.2022	Draft. Not officially approved
	Liçeni i Shkodrës	60, date 26.01.2022	Outdated. Revision in progress
	Kune-Vain-Patok-Fushëkuqe-Ishëm	60, date 26.01.2022	No
	Lumi i Bunës - Velipojë	10, date 28.12.2020	Approved until 2026.
	Liçeni i Pogradecit	80, date 18.02.1999	Approved 2017-2027

Table 57 - Areas of International Importance in Drin-Buna RB.

International protection categories	Name
EMERALD network	- Candidate sites: Managed Nature Reserve (Albanian part) of Shkodra lake / Rezerva Natyrore e Menaxhuar e Liçenit të Shkodrës (pjesa shqiptare)¹⁰³ - Candidate sites: Protected Landscape of Buna river - Velipoja / Peizazhi i Mbrojtur i lumit të Bunës-Velipoja¹⁰⁴ - Candidate sites: Shengjin-Ishëm.¹⁰⁵ - Candidate sites: Managed Nature Reserve of Berzane / Rezerva natyrore e Menaxhuar Berzane¹⁰⁶ - Candidate sites: Alps / Alpet¹⁰⁷ - Candidate sites: Protected Landscape of Korabi / Peisazhi i Mbrojtur i Korabit¹⁰⁸ - Candidate sites: National Park Rrajce-Shebenik / Parku Kombëtar Shebenik-Jabllanice¹⁰⁹ - Candidate sites: Allamani.¹¹⁰
RAMSAR Site	- Lake Shkodra and River Buna¹¹¹ - Albanian Prespa Lakes¹¹²
KBA ¹¹³	- Liçeni i Shkodrës - Lumi i Bunës - Velipojë - Vau i Dejës - Delta e Drinit - Thethi - Bjeshka e Oroshit - Vargmali Korab-Koritnik - Mali i Pashtrik – Morinë - Rrajca - Liçeni i Ohrit - Liçeni i Prespës së Madhe - Liçeni i Prespës së vogël
IBAs	- Lake Shkodra (Lake Scadar)¹¹⁴ - Thethi¹¹⁵

¹⁰³ <https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AL0000009>

¹⁰⁴ <https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AL0000021>

¹⁰⁵ <https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AL0000017>

¹⁰⁶ <https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AL0000025>

¹⁰⁷ <https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AL0000010>

¹⁰⁸ <https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AL0000023>

¹⁰⁹ <https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AL0000022>

¹¹⁰ <https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AL0000005>

¹¹¹ <https://rsis Ramsar.org/ris/1598>

¹¹² <https://rsis Ramsar.org/ris/2151>

¹¹³ <https://www.keybiodiversityareas.org/>

¹¹⁴ <https://datazone.birdlife.org/site/factsheet/lake-shkodra-lake-scarar>

¹¹⁵ <https://datazone.birdlife.org/site/factsheet/thethi>

	• Lura¹¹⁶ • Lake Ohrid and surrounding area¹¹⁷ • Liqeni i Prespes se Madhe¹¹⁸
UNESCO site	• Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe¹¹⁹ • Natural and Cultural Heritage of the Ohrid region¹²⁰

¹¹⁶ <https://datazone.birdlife.org/site/factsheet/lura>

¹¹⁷ <https://datazone.birdlife.org/site/factsheet/lake-ohrid-and-surrounding-area>

¹¹⁸ <https://datazone.birdlife.org/site/factsheet/lake-megali-prespa>

¹¹⁹ <https://whc.unesco.org/en/list/1133>

¹²⁰ <https://whc.unesco.org/en/list/99>

14 Annexes

The Drin-Buna River Basin Management Plan is supported by a set of technical Task Reports that provide the evidence base for WFD-compliant planning, assessment, and implementation. Together, these reports describe the water bodies, protected areas, monitoring networks, environmental objectives, pressures, measures, economic analysis, hydrology, stakeholder process, maps, and data inventories that underpin this RBMP.

14.1 Task Report 1 – Delineation of Water Bodies

Defines the surface water bodies and groundwater bodies that form the basic management units of the RBMP. It applies WFD typology, delineation criteria, and hydrogeological principles to ensure that each water body can be assessed, monitored, and managed against clear environmental objectives.

14.2 Task Report 2 – Register of Protected Areas

Identifies areas requiring special protection under WFD Article 6 and Annex IV. It covers drinking water protected areas, bathing waters, nutrient-sensitive areas, economically significant aquatic species and water-dependent habitats and species. The report links protected area objectives with the relevant surface water bodies and groundwater bodies.

14.3 Task Report 3 – RBMP Objectives and Overview of SWMIs

Sets out the overall river basin aims, environmental objectives and Significant Water Management Issues. It translates the main pressures and management challenges into strategic priorities for the Drin-Buna River Basin and provides the policy bridge between technical assessment and the Programme of Measures.

14.4 Task Reports 4a to 4f – Monitoring Network, Data Collection and Data Analysis

Assess the existing monitoring networks and available data for surface water, groundwater, protected areas, and relevant quality elements. These reports identify the current evidence base, data gaps and monitoring improvements needed to support WFD-compliant status assessment and future reporting.

14.5 Task Report 5 – Environmental Objectives, EQS, and Provisional Reference Conditions

Defines the technical framework for setting environmental objectives, environmental quality standards, and provisional reference conditions. It supports ecological, chemical, and quantitative status assessment for surface waters and groundwater, including the development of WFD-compatible assessment methods.

14.6 Task Report 6 – Drivers and Pressures Analysis

Identifies the main drivers, pressures and impacts affecting water bodies in the basin. It applies the WFD pressure-impact logic to assess point-source pollution, diffuse pollution, abstraction, hydro morphological alteration, groundwater pressures, climate pressures, and impacts on coastal and protected areas.

14.7 Task Report 7 – Programme of Measures

Translates the pressure and status assessment into basic and supplementary measures. It links pressures and Key Types of Measures, and defines the actions required to prevent deterioration, reduce risks and progress towards good status, good ecological potential, and protected area objectives.

14.8 Task Report 8 – Initial Economic Analysis of Water Uses, Revenue Analysis and Cost Recovery

Provides the economic basis for the RBMP. It assesses water uses, economic drivers, financing mechanisms, revenue flows, and cost-recovery principles, supporting the WFD requirement to integrate economic analysis into water management and the Programme of Measures.

14.9 Task Report 9 – Hydrological Analysis

Describes the surface water balance of the basin. It supports the assessment of water availability, abstraction pressure, environmental flows, drought vulnerability, groundwater recharge and the interaction between water quantity and ecological status.

14.10 Task Report 10 – Technical Workshops

Documents the stakeholder and expert workshops held during the development of the RBMP and Programme of Measures. It records technical discussions, institutional inputs, and stakeholder contributions, thereby supporting transparency, coordination, and participatory river basin planning.

14.11 Task Report 11 – Atlas of Maps of the Basin

Provides the spatial presentation of the RBMP evidence base. It includes a set of basin wide maps of all relevant topics for the Drin-Buna River Basin.

14.12 Task Report 12 – Inventory of Relevant River Basin Management Data

Compiles the key datasets used for the RBMP. It supports data traceability, consistency and future updates of the river basin management cycle and provides a basis for strengthening national water information systems and WISE-compatible reporting.

15 References

CONCEPT