Dora Baltea basin

monograph

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Summary

SHORT DESCRIPTION
This document intends to provide a comprehensive description of the Dora Baltea river basin including the HP plants on which will be tested the MCA methodology. This monograph is divided into five different sections, each of which explores a specific topic. The first part describes in general the physical, geographical, geological and hydrological characteristics of the basin. The second part is a deepening on present management and monitoring plans, and the third analyzes the main water uses on a basin scale with particular attention to the HP exploitation. Finally the fourth and fifth parts provide a description of the main pressures and impacts related to water uses and their relative restoration and mitigation actions.

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Table of contents

Introduction

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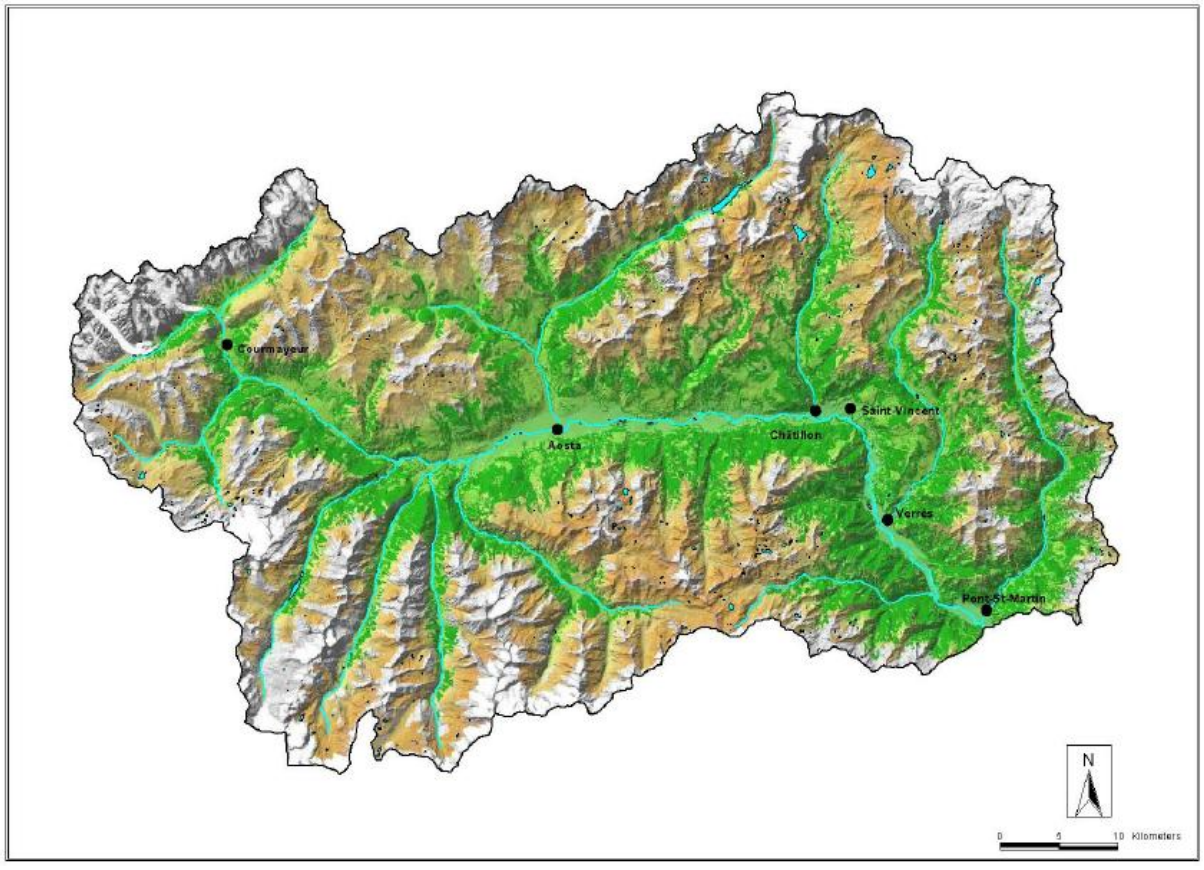
This monograph is divided into five different sections, each of which explores a specific topic. The first part describes in general the physical, geographical, geological and hydrological characteristics of the basin. The second part is a deepening on present management and monitoring plans, and the third analyzes the main water uses on a basin scale with particular attention to the HP exploitation. Finally the fourth and fifth parts provide a description of the main pressures and impacts related to water uses and their relative restoration and mitigation actions.

1. Pilot case study area

1.1 Basin characteristics

The Dora Baltea basin includes an important hydrographic network that stretches from the Piedmont to the entire North-Western Region of Valle d'Aosta, with a basin of over 3.261 km^2. Dora Baltea represents one of the five major tributaries of the River Po with average annual contributions equal to 110 m^3/sec.
The river originates with its two branches, the Dora of Veny valley and the Dora of Ferret valley, from the glaciers of Mont Blanc. From the confluence of the two at the mouth of the Po river the Dora river has a length of about 152 km [**Image 1**].

Image 1 - The Dora Baltea river basin included in the Aosta Valley region [extracted from the Aosta Valley River Basin Management Plan, 2006].



The track is initially directed from northwest to southeast, shortly before Aosta town assumes trend west-east just to Saint Vincent town, where it was heading south-east, keeping to the confluence.
The Dora river receives numerous tributaries on both sides and flows with sinuous at times sub-straight in a valley carved with rather steep rock slopes.
The tributaries of the right side deriving from all the northern slopes of the Gran Paradiso, that separates the Aosta Valley region to the adjacent basin of Orco river; the streams are: Dora of La Thuile, Dora of Valgrisanche, Dora of Rhemes, Savara river, Grand'Eyvia river, Clavalité river, Chalamy and Ayasse rivers.
On the left side the main tributaries, which flow from the peaks of the Cervino and Monte Rosa are Buthier river, St. Barthelemy river, Marmore, Evançon and Lys rivers [**Table 1**].

Table 1 - The main sub-basins of the Dora Baltea river basin.

MAIN SUB-BASINS	AREA [KM^2]
Evançon - Marmore	454
Lys	284
Dora of Verney and Dora of Valgrisenche	301
Dora of Rhêmes, Savara and Grand Evyia rivers	534
Dora Baltea	802
Buthier – Artanavaz	454
Saint Marcel, Clavalité, Chalamy and Ayasse rivers	241
Dora of Ferret and Dora of Veny	191
TOTAL AREA OF THE BASIN [included in the Aosta Valley region]	**3261**

In the basin there are 707 lakes, including natural and artificial lakes, for a total area of approximately 9.5 km^2. Most of the lakes lies at an altitude between 1000 m and 3000 m asl.
In these lakes are included numerous seasonal or weekly reservoirs [**Table 2**]. All of this make a regulation of outflows for the hydropower production. [For further details consult the Aosta Valley River Basin Management Plan. 2006].

Table 2 - The main reservoirs of the Dora Baltea river basin.

RESERVOIR	HYDROGRAPHIC BASIN	AREA [KM^2]	CAPACITY [MILLION OF M^3]	USEFUL CAPACITY [MILLION OF M^3]
Vargno	Dora Baltea	\	1,1	\
Miserin	Dora Baltea	\	0,7	\
Beauregard	Dora Baltea	93,6	72,0	70,0
Place Moulin	Dora Baltea	74,0	106,0	105,0
Goillet	Dora Baltea	6,3	11,8	11,0
Cignana	Dora Baltea	13,5	16,2	16,0
Gabiet	Dora Baltea	3,0	4,4	4,4

1.2 Geolithological and land cover characterization

The Dora Baltea river basin is characterized by the presence of the higher mountains of Europe [i.e. Monte Bianco (4810), Cervino (4474), Grandes Jorasses (4208), Gran Paradiso (4061), Lyskamm(4477)] distinguished by the presence of perpetual glacier, but also by the presence of the main plane that comes down just to 300 m asl. These characteristics contributed to keep the natural conditions of a large part of the territory although the deep anthropization of the Dora Baltea plane.
Due to the great proportionality of the territories placed above the 1500 m slm (about 80% of the basin) the 40% of the Dora Baltea river basin presents a rocky or icy surface, the 51% is covered by forest and pasture land and only the 9% support the human settlements: this part is essentially the central plain [**Table 3**].

Table 3 – Geographical data of the Dora Baltea river basin included in the Aosta Valley region. [extracted from the Aosta Valley River Basin Management Plan, 2006].

RESERVOIR	DATA	EXTRACTED FROM
Area	3261 Km^2	Piano Stralcio per l'Assetto Idrogeologico – Autorità di Bacino del Fiume Po, 2001
Height max	4810 m	(Mercalli, 2003)
Height min	312 m	(Mercalli, 2003)
Average height	2103 m	(Mercalli, 2003)
Glacial area	170,58 Km^2	(Banca Dati Glaciologica Regionale, aggiornata al 2000 su base cartografica 1991)

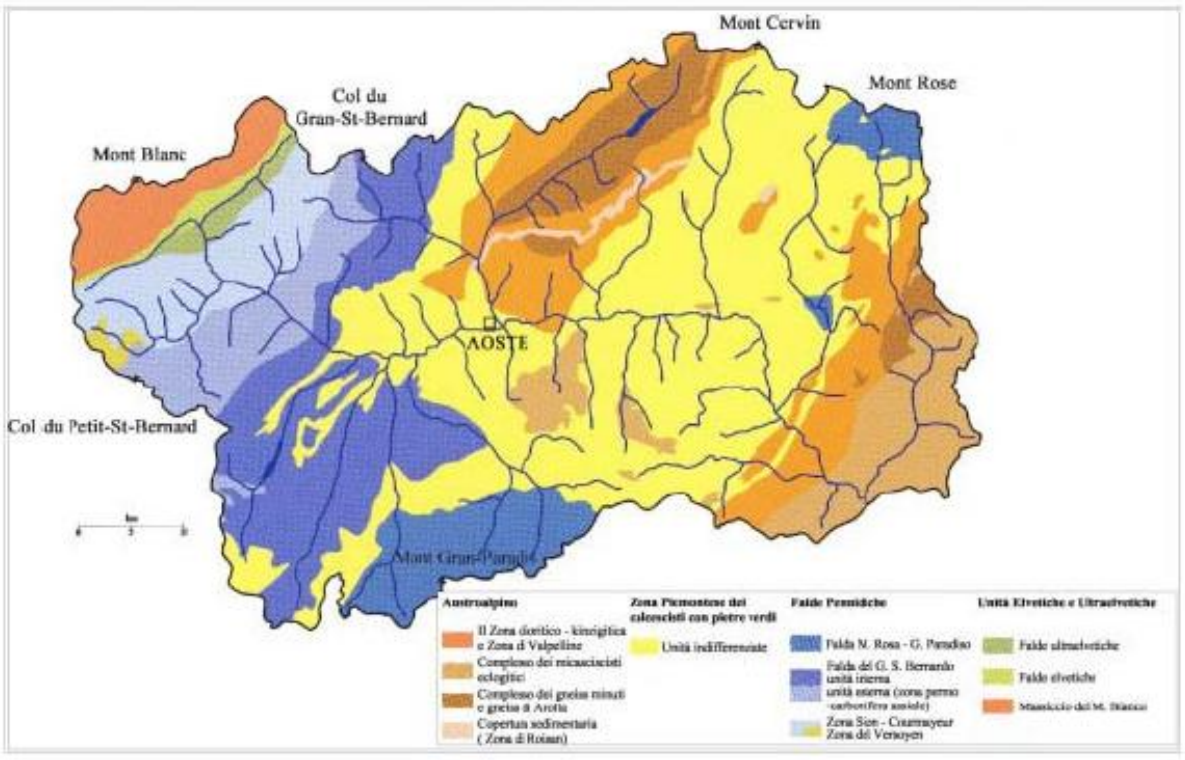
Forest area	865,5 Km^2	(Corpo Forestale della Valle d'Aosta)
Lake area	9,5 Km^2	(ARPA Valle d'Aosta)

In geomorphologic terms the mountain basin of the Dora Baltea can be divided into three different areas:

- High basin of the Dora Baltea river - including the highest basin area, which stretches from the Monte Bianco to the plain of Aosta town;
- Middle basin of the Dora Baltea - coinciding with the plain area that extends between Aosta and Montjovet town;
- Low basin of the Dora Baltea which extends from Montjovet town to the plain of Ivrea town.

From the geological point of view, the mountain basin of the Dora Baltea was part of the mountain range area called the Western Alps, a collision range structured in superimposed layers [Sistema Austroalpine System, Piedmontese Zone, Higher Pennidic Units, Middle Pennidic System of the Gran San Bernardo, External Pennidic Units and Elvetic-Ultraelvetic System] forming a complex structure.
All of these geological and structural characters influence significantly the evolution of the mountains and also the dynamics of valley slopes.
All the superficial formations have a quaternary origin and they are formed by glacial deposits, alluvial deposits of the Dora Baltea and its tributaries, lake deposits and colluvial deposits.
The glacial deposits are divided mainly into deep glacial deposits, ablation and glacial contact. Throughout the basin, the main morphological mark is given by the overlap of river morphological modeling operated by the Dora Baltea river and its tributaries on the glacial building.
Important accumulation forms are present at the mouth of the secondary valleys linked to tributaries action, whereas along the Dora Baltea river there are several orders of alluvial terraces.
The alluvial deposits of Dora Baltea river consist of alternations of gravel sand and silt, while the tributaries deposits are pebble gravel and blocks. The lake deposits type consist of silt and sand interstratified. [For further details consult the Aosta Valley River Basin Management Plan. 2006] [**Image 2**].

Image 2 - The geological map of the Dora Baltea basin included in the Aosta Valley region [extracted from the Aosta Valley River Basin Management Plan. 2006].



For the land cover characterization is available the Land Cover chart prepared for the CORINE Land Cover project [COoRdination de l'Information sur l'Environnement] 2000. This is the most recent and updated information regarding the Aosta Valley land coverage, based on satellite images of 2000.
The land cover map at 1:100,000 scale with a legend of 44 items, is referred to homogeneous spatial units clearly distinguished from units that surround them.
In the Dora Baltea river basin there are the land cover typologies shown below [**Table 4**].

Table 4 – The CORINE land cover typologies of the Dora Baltea river basin. [extracted from the Aosta Valley River Basin Management Plan, 2006].

CORINE CODE	TYPOLOGY	AREA [KM^2]
111	Continuous urban fabric	1,621
112	Discontinuous urban fabric	35,143
121	Industrial or commercial units	6,808
124	Airports	0,424
131	Mineral extraction sites	0,258
133	Construction sites	2,150
142	Sport and leisure facilities	0,652
211	Non irrigated arable land	0,739
221	Vineyards	3,443
222	Fruit trees and berry plantations	2,477
231	Pastures	112,468
242	Complex cultivation patterns	20,647
243	Land principally occupied by agriculture, with significant areas of natural vegetation	119,590
311	Broad-leaved forest	78,448
312	Coniferous forest	609,601
313	Mixed forest	91,176
321	Natural grassland	351,789
322	Moors and headland	156,967
324	Transitional woodland-shrub	354,694
332	Bare rocks	725,340
333	Sparsely vegetated areas	425,034
335	Glaciers and perpetual snow	149,265
411	Inland wetlands	1,049
511	Water courses	0,187
512	Water bodies	3,318

The development map produced for the Aosta Valley River Basin Management Plan has simplified the map CORINE Land Cover aggregating certain types, such as continuous and discontinuous urban fabric which have been reunited in one type [urban fabric]. From the reworking of the surfaces were obtained the following results expressed in Km^2 and percentages [**Table 5**].

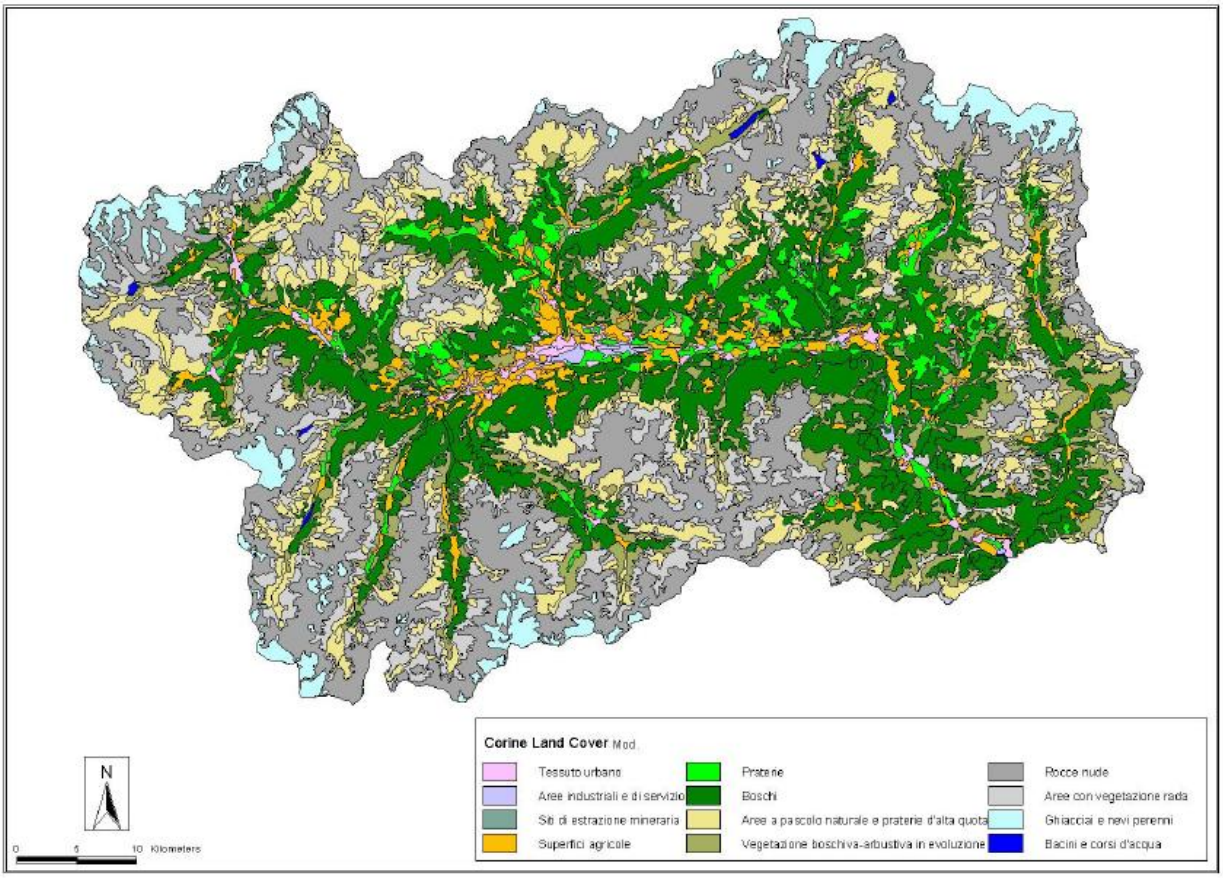
Table 5 – Simplification of CORINE Land Cover typologies for the Aosta Valley River Basin Management Plan. [extracted from the Aosta Valley River Basin Management Plan, 2006].

LAND COVER TYPOLOGY	AREA [KM^2]	PERCENTAGE
Urban fabric	36,765	1,130
Industrial or services units	10,035	0,308
Mineral extraction sites	0,258	0,007
Agricultural surfaces	146,158	4,492
Pastures	113,208	3,479
Forest	779,225	23,951
Natural and high altitude grassland	508,756	15,638
Transitional woodland-shrub	354,694	10,902
Bare rocks	725,340	22,295
Sparsely vegetated areas	425,034	13,064

Glaciers and perpetual snow	149,265	4,588
Water courses and bodies	4,554	0,139

The map of land cover modified from the CORINE Land Cover 2000 for the Dora Baltea river basin is shown below [**Image 3**].

Image 3 - The map of land cover modified from the CORINE Land Cover 2000 for the Dora Baltea river basin [extracted from the Aosta Valley River Basin Management Plan. 2006].



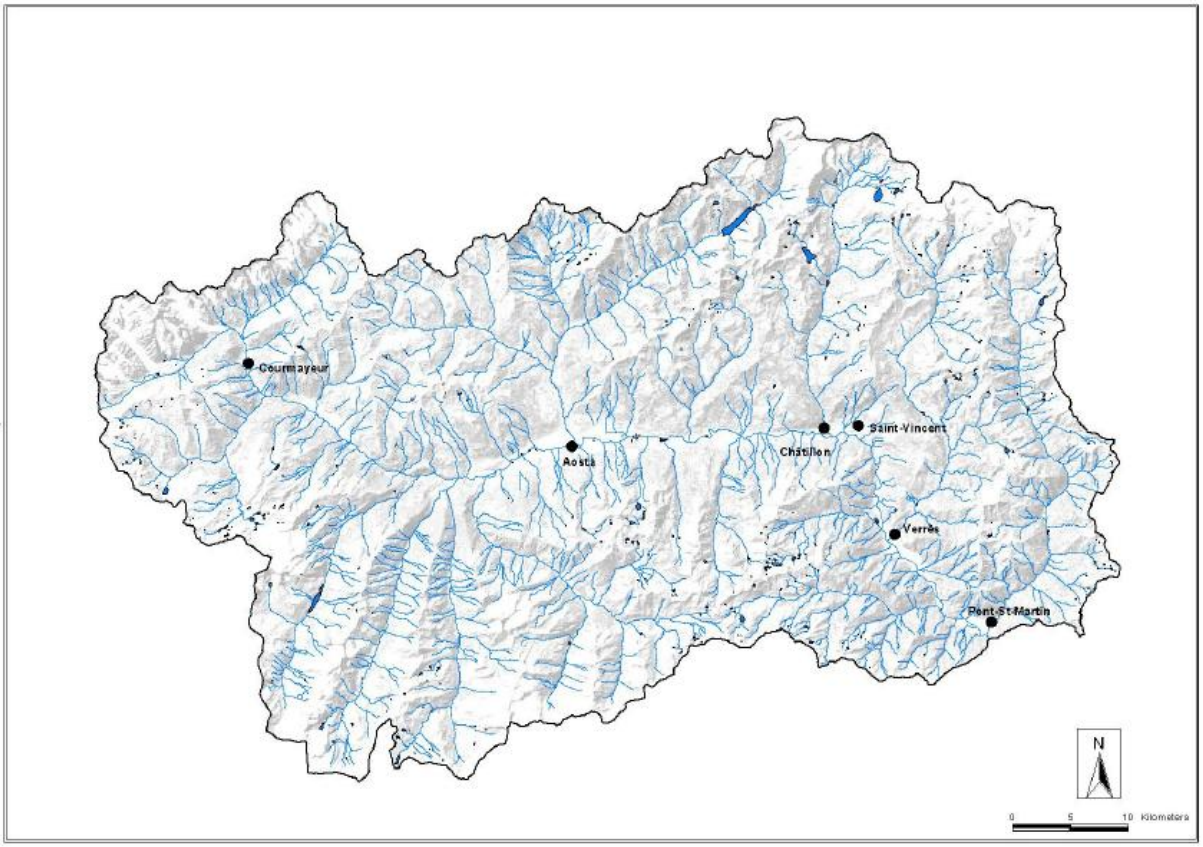
[For further information about the CORINE Land Cover 2000 for the Dora Baltea river basin is possible to consult the Aosta Valley River Basin Management Plan, 2006].

1.3 Hydrological characterization

The presence of glaciers heavily influences the Dora Baltea flow regime with pronounced winter minimum and summer maximum in accordance with the period of maximum glacier ablation.
The Dora Baltea basin is classified as an inland alpine basin just to the confluence of the river Lys. The mountain ranges offer a direct protection against humid air from the Atlantic and therefore have rather modest rainfall totals in terms of intensity [**Image 4**].
The main meteo-climatic characteristics of the Dora Baltea river basin are:

- A thermal distribution that faithfully follows the mountain profile with the average value of 10°C in the plan, the average value of 0°C at the height of 2500 m slm and the average value of -5°C at the height of 3400 m slm [extracted from the "*Atlante climatico della Valle d'Aosta*", L. Mercalli et al.] [**Image 5**]
- A distribution of precipitations that shows yearly average values of 500 mm/y in the central part of the basin and yearly average values of 2000 mm/y in the North-West and South-East sectors [**Image 6**]

Image 4 - The hydrography of Dora Baltea river basin [extracted from the Aosta Valley River Basin Management Plan. 2006].



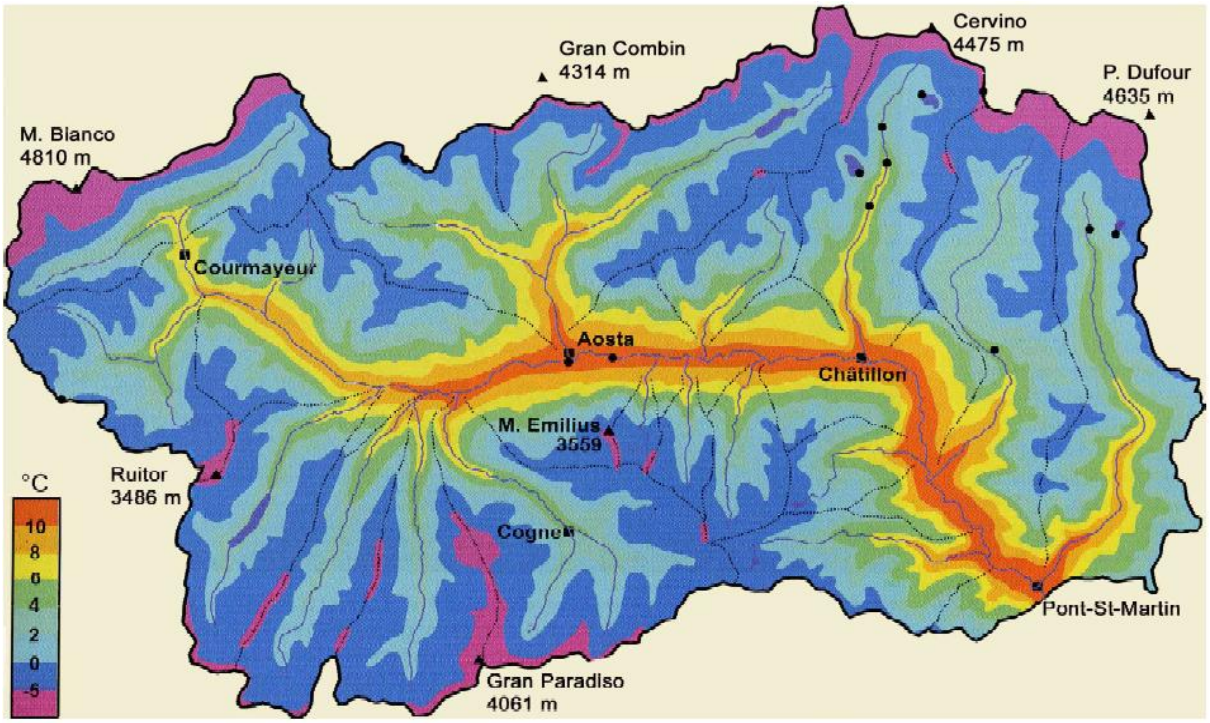
From the hydrological point of view the transformation of inflows in runoff is strongly influenced by these characteristics and in particular by the presence of snowfields and glaciers.
In fact, since the mountain basin consists of vast areas above 2000 m asl, the rainfall occurs for a long part of the year mainly as snow and does not contribute to the formation of the flood.
The distribution of flow has the maximum from June to July to coincide with the melting of snow and ice and the minimum in winter.
Floods generally occur between late spring and early autumn, when the snowfall is proportionally low. Sometimes, especially in late spring, the presence of a still substantial snowpack causes a significant increase in the contribution of flood for the effect of melting snow.
In this geographical area, a typical inland alpine basin, often the occurrence of critical floods don't correspond to the maximum intensity values of rainfall recorded by the rainfall stations, but to the coincidence of a number of negative factors (in addition to high intensity rainfall) including essentially the occurrence of abnormal temperature rises and the presence of a large blanket of snow.
In the secondary basins occur frequently floods caused by rain or storms of great intensity but low extension. In these cases there may be significant sediment transport phenomena.
In the table shown below [**Table 6**] are represented the historical series of maximum flows of Dora Baltea river in Aosta town, measured by the hydrometric monitoring station of SIMN extracted from the Aosta Valley River Basin Management Plan, 2003.

Table 6 – historical series of maximum flows of Dora Baltea river in Aosta town. [extracted from the Aosta Valley River Basin Management Plan, 2006].

Q_{MAXC} (M^3/S)	317	351	227	204	200	156	112	208	216	294	465	175	348	157	325
YEAR	1934	1936	1938	1939	1940	1943	1944	1950	1953	1954	1955	1956	1957	1959	1960

The examination of rainfall data confirms the inland alpine basin type, which leads to lower contributions to the western portion of the full catchment of the Po river. [For further details consult the Aosta Valley River Basin Management Plan. 2003].

Image 5 - The yearly average isotherm chart (in °C) of Dora Baltea river basin [extracted from the Aosta Valley River Basin Management Plan. 2006].



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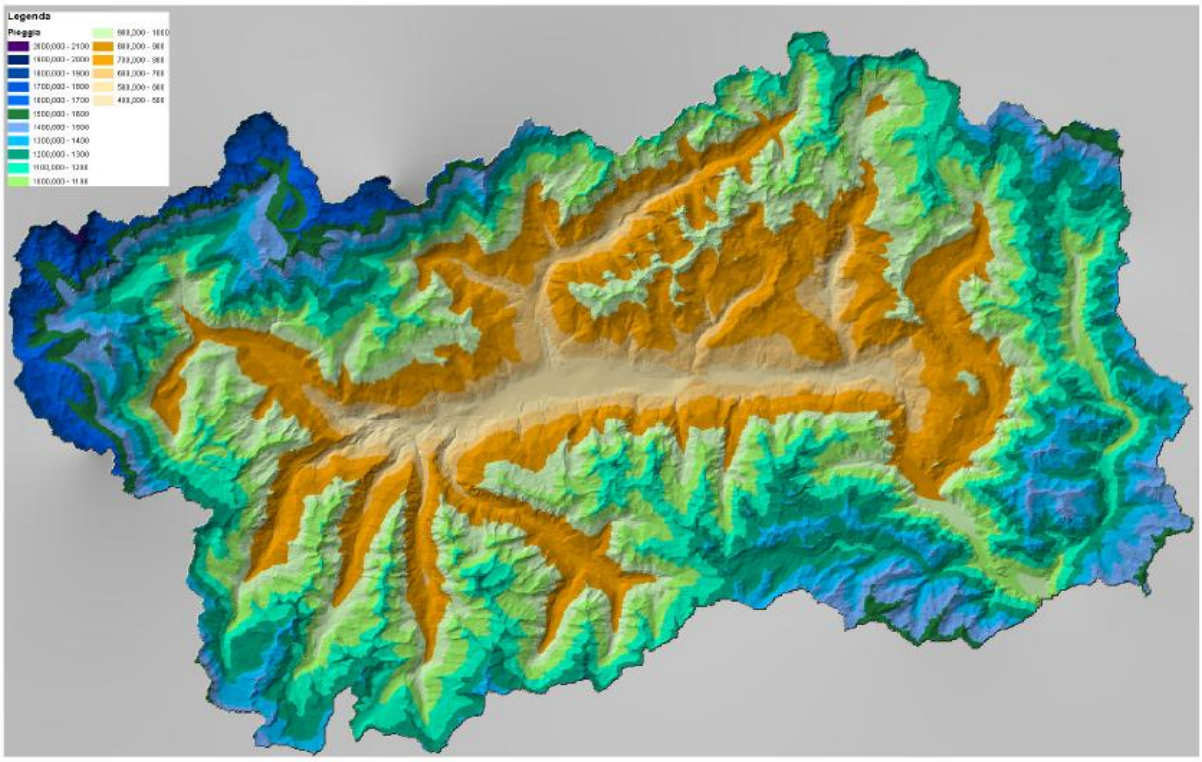


1.4 River quality

WFD quality elements

In Italy the Directive 2000/60/EC has been implemented recently by the D.lgs. 56/2009 of the Ministry of Environment. Thus the data collected for the Dora Baltea river basin are not currently sufficient for a characterization for the WFD. By the end of 2010 will be available for regional hydrographic network, the first information about some biological components such as macroinvertebrates, diatoms and phytobenthos. The data relevant to testing the Dora Baltea river basin on the SHARE project are described in detail in paragraph 2.2 Monitoring programs for the following components:

- **LIM [Livello di Inquinamento da Macrodescrittori]**: a synthetic index composed by seven chemical and microbiological macrodescriptors and articulated on five quality classes expressed by a numerical value;
- **LIM_{eco} [Livello di Inquinamento da Macrodescrittori per lo stato ecologico]**: the level of pollution expressed by Macrodescriptors for the ecological status indicator essentially defines the pollution level expressed by macrodescriptors referred to nutrients and oxygen;
- **STAR_ICMi [Indice Multimetrico STAR di Intercalibrazione]**: the STAR_ICMi [STAR Intercalibration Common Metric index] is a multimetric index composed of six metrics that provide information on the main aspects that the WFD calls to consider for the analysis of macrobenthic community [composition and abundance] and is directly expressed in terms of Ecological Quality Ratio [EQR];
- **IBE [Indice Biotico Esteso]**: deriving from the EBI [Extended Biotic Index] this index is founded upon the analysis of the macroinvertebrates community structure that colonizes the different river typologies. The index appraises how the present macroinvertebrates community is far from the attended one. It's articulated on five quality classes expressed by a numerical value;
- **Ecological Status of river [SECA index]**: this index is obtained by the intersection of LIM and IBE indices;
- **Chemical status**: the micropollutants and dangerous chemical elements concentration in the water are tested to monitoring that the concentration of each parameter not exceeds the values threshold foreseen by the Directive 76/467/EC and D.lgs. 152/1999;
- **Environmental status of the river [SACA]**: this index is obtained by the intersection of SACA index and chemical status;
- **ICMi [INTERCALIBRATION COMMON METRIC for Phytobenthos]**: this indicator expresses a quality judgment of river environments on the base of the diatomic community composition modifications, induced from factors of waters and sediments pollution and/or from meaningful physical and morphological alterations of the bankfull;
- **IBMR [Indice Biologique Macrophytique en Rivière]**: the Indice Biologique Macrophytique en Rivière (IBMR) is a macrophyte Index based on the use of more than 200 marker taxa of which is evaluated the presence and the abundance. This indicator provides, on the macrophyte community's base, information about the biological quality of surface water, particularly about the trophic levels of river.

WFD HER typology

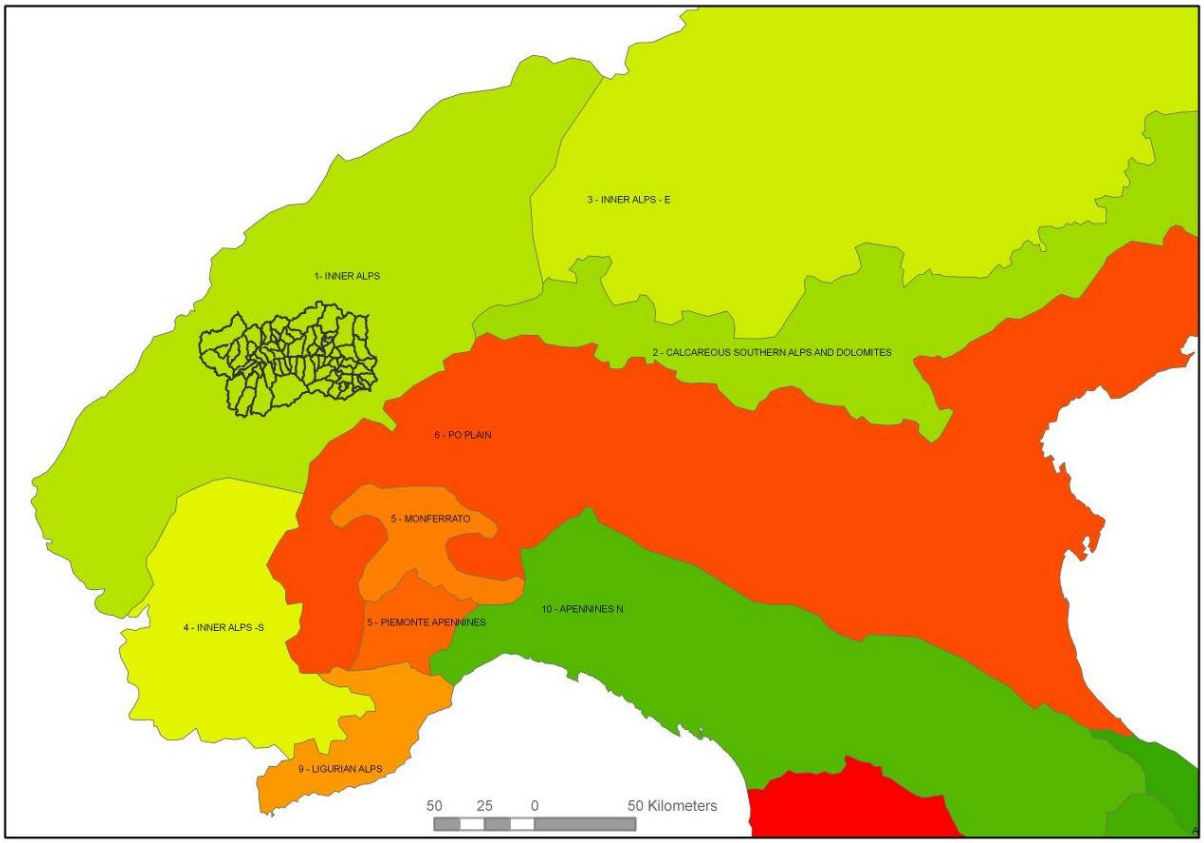
The approach developed by MATTM and established by Decree N. 131 June 16, 2008 is divided into three successive levels:

- **Level 1** - Regionalization: identification of the Hydro-Ecoregion (HER) membership (required);
- **Level 2** - Defining a typology based on general descriptors: distance from river source (Basin size), longevity and persistence, riverbed morphology, river basin source and upstream influence (required);
- **Level 3** - Definition of a type of detail (optional).

The Dora Baltea river basin, embodied in the Aosta Valley region, is totally included into the "1 – Inner Alps" HydroEcoRegion [**Image 7**].
The methodological approach developed by CEMAGREF in France is based on minimum European areas (HER - HydroEcoRegions) that present a limited variability for certain descriptors (altitude,

latitude, longitude, average slope of the river, precipitation, air temperature, geological composition of the substrate). The boundaries of the different HERs were subsequently adapted to the Italian territory by the competent bodies including Basin Authority and Regions. [extracted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

Image 7 – HydroEcoRegions present in the North-West of Italy [extracted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].



WFD river typology

The definition of the river typology took place according to the flow chart proposed by Buffagni et al. (2006) and formalized in Decree 131/2008, for the allocation of river stretches to a "typology" within the meaning of System B defined by Directive 2000/60/EC , which considers the following descriptors:

- Longevity and persistence;
- Riverbed morphology;
- Distance from river source (Basin size);
- River basin source;
- Upstream influence.

The Dora Baltea river basin, included in the Aosta Valley region, was classified in 4 different typologies [**Image 8** and **Table 7**]. To each river typology was assigned an alphanumeric code shown below:

HER		Orig/Pers		Dist/ Morf	IBM

The 1st and 2nd numbers are referred to the HER [01 – Inner Alp for all the Aosta Valley region], the 3th and 4th character are referred the river origin [i.e. GH= glacier] and the 5th is referred to the river size [1= very small, …5= big]. The last character shows the basin influence but for the Dora Baltea river basin included into the Aosta Valley river is not applied [N=not applied]. [extracted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

Image 8 – Dora Baltea river typology [extracted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

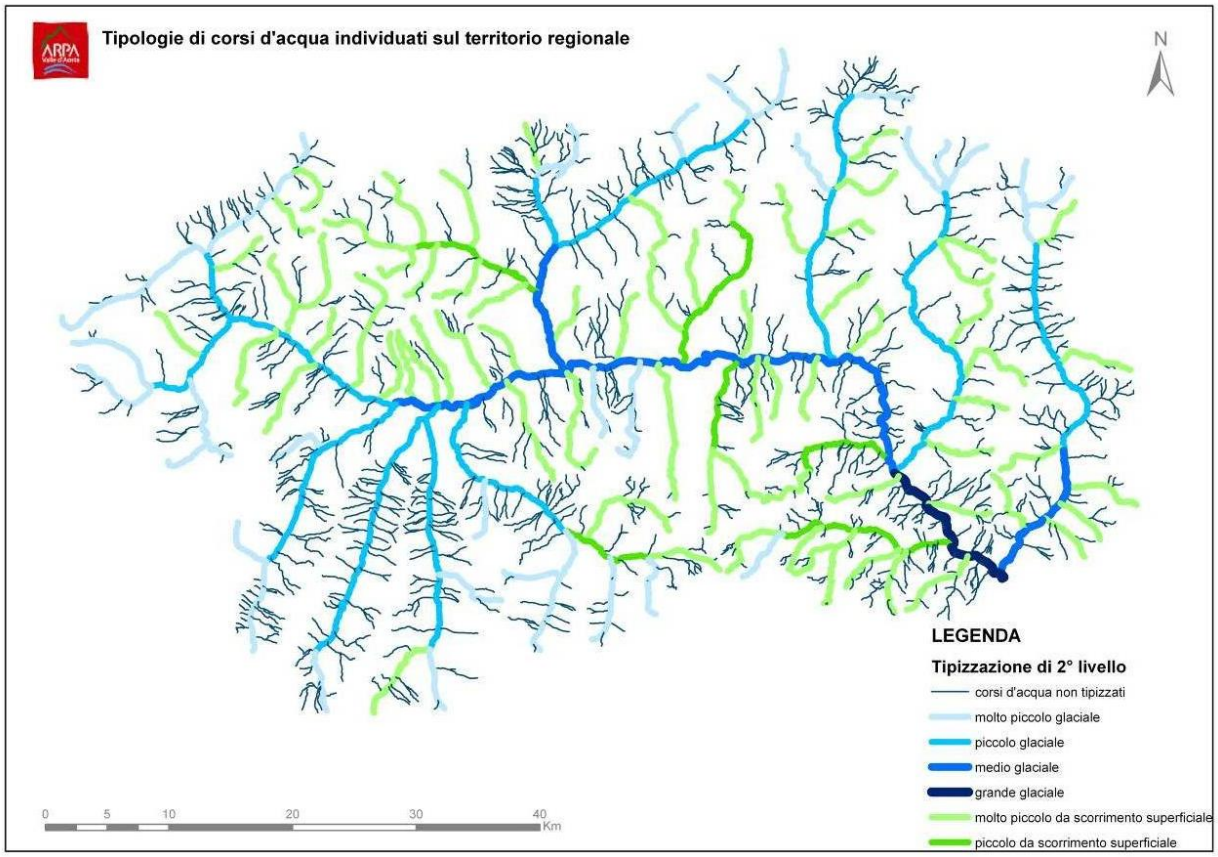


Table 7 - The Dora Baltea river typologies.

RIVER	TYPOLOGY	LENGTH [KM]	TYPOLOGY DESCRIPTION
Dora Baltea	01GH1N	15,63	very small glacial
Dora Baltea	01GH2N	22,46	small glacial
Dora Baltea	01GH3N	54,92	middle glacial
Dora Baltea	01GH4N	14,10	big glacial

2. Plans and management programs

2.1 Existing management plans and application rules

Regional Energy Plan

The purpose of the Aosta Valley Regional Energy Plan [2003], is to identify actions to allow the adjustment of energy demand, which is necessary for the conduct of civil and productive activities, and conditions of energetic supply for the competent area, with the goal of maximizing the relationship between economic and social benefits of energy development and its total costs, including those regarding environmental and social.
The Regional Energy Balance drawn from 1990 to 2000 provides an overview of all flows of energy to end-use. This budget shows a substantial surplus between production and power consumption varies from year to year, with average value of 1.975 GWh.
The Hydropower is energy technology leader in the Aosta Valley region and is mostly exported to the rest of the country. The hydraulic source has reached a level of exploitation almost complete in Aosta Valley[for details see paragraph 3.1]. However, according to studies on hydroelectric resources remaining, has been identified a number of HP plants potentially feasible and economically affordable. These plants, could make a contribution in the order of 50 to 100 GWh / year and are the result of skimming in function of techno-economic feasibility, constraints arising from park and / or protected areas and administration. [for further details consult the Aosta Valley Regional Energy Plan, RAVA - 2003].

River Basin Management Plan

The River Basin Management Plan defines the set of measures by which meet the general objectives expressed in the D.lgs. n.152/1999:

- Prevent and reduce pollution and implement the restoration of polluted water bodies;
- Improve the water health and identify adequate protections for those destined to particular uses;
- Achieve lasting and sustainable use of water resources;
- Maintain the natural ability to self-purification of water bodies, and the ability to support flora and fauna communities large and well diversified.

It establishes all the actions to ensure by 2016 to achieve or maintain intermediate and final goals, of water bodies quality foreseen by the Directive 2000/60/EC [WFD] and the measures necessary to protect qualitatively and quantitatively the whole system of surface water and groundwater.
Then the Plan defines the protection and restoration measures of regional water bodies and the sustainable use of water resources through integrated measures of qualitative and quantitative protection of resources.
The qualitative measures of water resources protection provide the natural self-purification of water bodies and their ability to support flora and fauna communities large and well diversified.
The quantitative measures of protection guarantee preservation, conservation and reuse of water resources to not compromise and to use the regional water resources, with priority for drinking water use, while respecting the environmental conditions of water bodies.
The plan sets out an intervention strategy that has three main objectives in order to mitigate or eliminate the effects resulting from problems encountered:

- Objectives of environmental quality and specific target;
- Objectives of protection and rehabilitation of the river ecosystem;
- Objectives of quantitative protection.

For each objective there are specific actions, consisting of structural and regulatory initiatives to:

- Improve the rivers health conditions, through the realization of environmental redevelopment actions and regulating the implementation of actions to protect the environmental components and the ichthyofauna in the river bed;
- Improve water quality through the fulfillment of waste water treatment system and the reorganization of the Integrated Water Service;
- Protect the hydrological regime and river environment by determining the Minimum Instream Flow (MIF).

The Plan provides the necessary framework for the Aosta Valley Region bodies, municipalities, mountain communities, individual or group for all choices have an effect on water resources.
The Plan is therefore an instrument which coordinates different aspects of regional planning and the promoter of coordination efforts and of experimental pilot projects (from bioengineered methodologies to sustainable energy exploitation). [For further details consult the Aosta Valley River Basin Management Plan. 2003]

Landscape Conservation Plan

The Landscape Conservation Plan is a tool that aims to ensure sustainable development that safeguards the right of everyone to enjoy the area's resources.
It expresses the principles of protection and enhancement of the landscape, the principles aimed at ensuring ecological stability and also regulates the intended use of the areas belonging to the river ecosystem.
The river ecosystem becomes a landscape element characterized by water resources valorization and upgrading of river ecosystems for different uses and activities including farming, breeding, energy production, tourism, sport etc..
In the Landscape Conservation Plan the improvement of water safety aspects are merged with improvement of the naturalness degree, of the efficiency and of the continuity of river ecosystems.
The plan also aims to eliminate degradation of existing situations and to restore as much as possible the evolutionary dynamics of natural water courses. [For further details consult the Aosta Valley Landscape Conservation Plan. 1998]

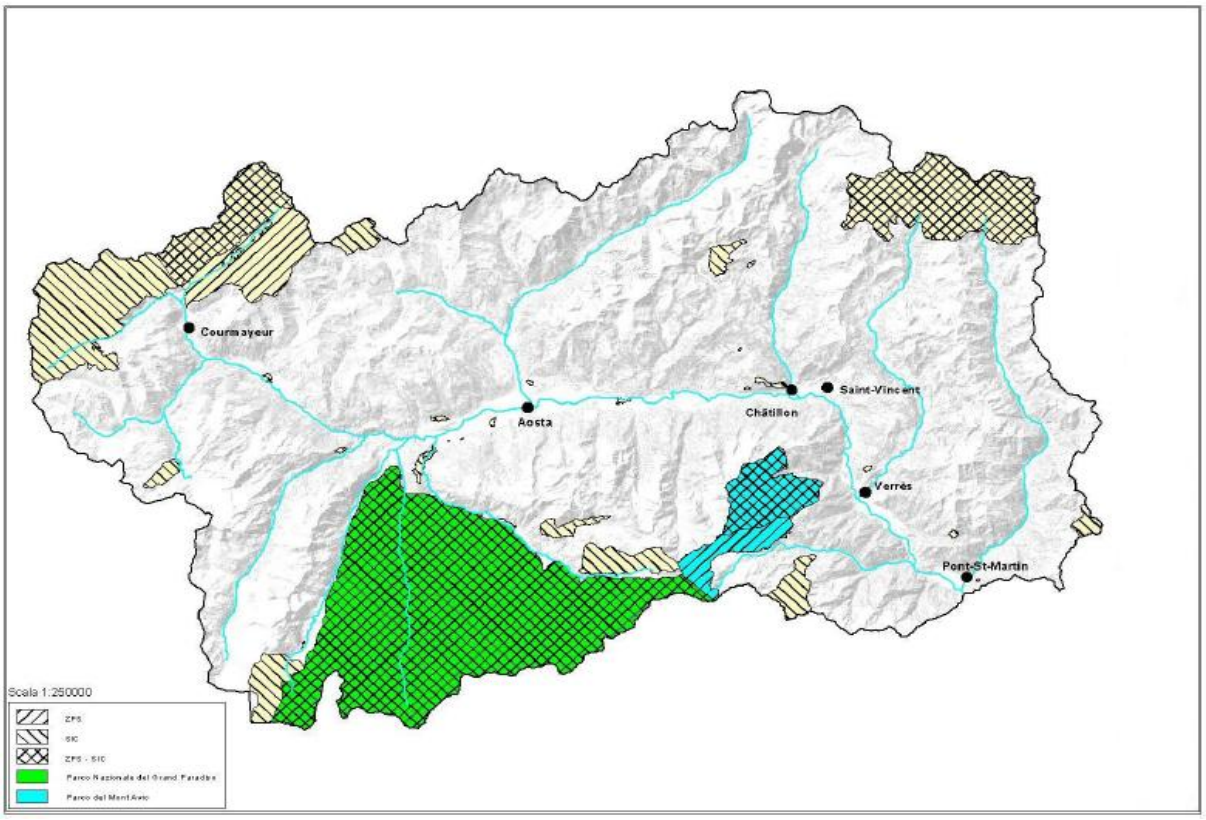
Protected Areas Management Plans – Natura 2000

Much of the Dora Baltea river basin is characterized by a high degree of naturalness. To protect biodiversity and natural environments which characterize this area were established numerous protected areas including the Gran Paradiso National Park Natural, Mont Avic Natural Park and 9 reserves established pursuant to R.L. 30/1991.
The protected areas are included in the Natura 2000 ecological network foreseen by the Directive 92/43/EC [Habitats Directive] that counts in the Dora Baltea river Basin a total of 26 Sites of Community Importance [SIC] and 4 Special Protection Areas [SPA] implementing Directive 79/409/EEC [Birds Directive] [**Image 9**]. Besides these there are also three Sites of National and Regional Importance [NIS and RIS].
Many are the environments tied to the water resources protected by the Protected Areas System and by the Natura 2000 ecological network and in particular:

- Alpine peat land
- Mid-mountain lakes
- Valley river banks

Regarding the Dora Baltea river banks, there are some sections which are specifically protected because included in nature reserves/SIC such as Les Iles de Saint Marcel and the Marais in Morgex. The protection of these areas comes from the weakness and fragmentation of remaining areas that make them particularly vulnerable and susceptible to alteration and their classification as "priority habitat" in accordance with Directive 92/43/EC.

Image 9 – Map of the protected areas of Dora Baltea river Basin [extracted from the Aosta Valley River Basin Management Plan. 2006].

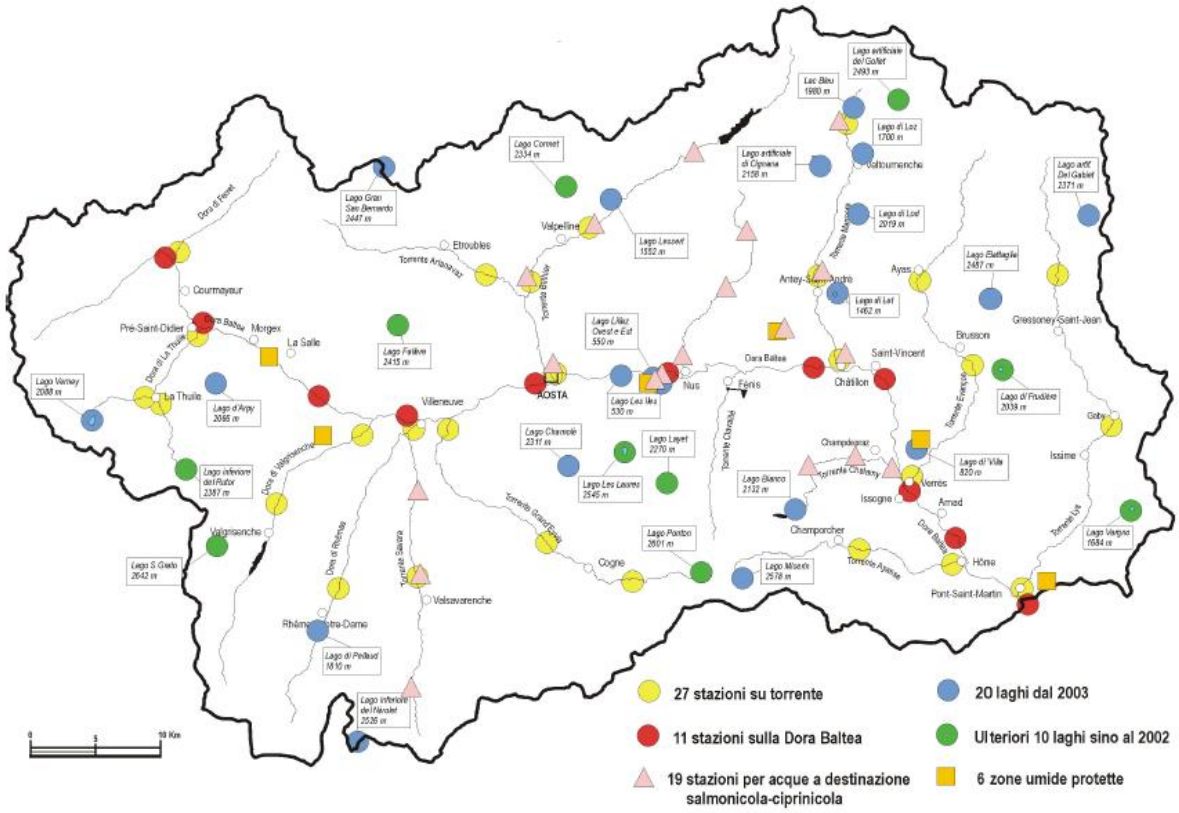


2.2 Monitoring programs

The monitoring network of the Dora Baltea river basin is managed by ARPA Valle d'Aosta and until 2008 was composed of [**Image 10**]:

- 38 monitoring stations on surface watercourses;
- 20 monitoring stations on the lakes;
- 19 monitoring stations for “salmonicol and cyprinicol” waters.

Image 10 – Map of monitoring network of Dora Baltea river Basin until 2008 [extracted and modified from the Aosta Valley River Basin Management Plan. 2006].



This monitoring network is operative since 1983 and the indices and parameters considered are shown below:

- **LIM [Livello di Inquinamento da Macrodescrittori]**: a synthetic index composed by seven chemical and microbiological macrodescriptors and articulated on five quality classes expressed by a numerical value;
- **IBE [Indice Biotico Esteso]**: deriving from the EBI [Extended Biotic Index] this index is founded upon the analysis of the macroinvertebrates community structure that colonizes the different river typologies. The index appraises how the present macroinvertebrates community is far from the attended one. It's articulated on five quality classes expressed by a numerical value;
- **Ecological Status of river [SECA index]**: this index is obtained by the intersection of LIM and IBE indices;
- **Chemical status**: the micropollutants and dangerous chemical elements concentration in the water are tested to monitoring that the concentration of each parameter not exceeds the values threshold foreseen by the Directive 76/467/EC and D.lgs. 152/1999;
- **Environmental status of the river [SACA]**: this index is obtained by the intersection of SACA index and chemical status.

According to the Directive 2000/60/EC (WFD), the general status objective for all river typologies is the achievement of the good surface water status by the end of 2015. For each water body the definition of the quality status must be carried out through the assessment of the following biological elements:

- Composition and abundance of aquatic flora (diatoms and macrophytes);
- Composition and abundance of benthic invertebrate fauna;
- Composition, abundance and age structure of fish fauna.

To evaluate the ecological status of different communities the WFD compares the community actually present in a specific site and the community present in absence of pressures (reference conditions).

The ecological status is given by the lowest class resulting from the monitoring data of biological elements. This value is compared with the physical-chemical quality elements, integrated in the index called LIM_{eco}. The overall ecological status is given by the lowest value between biological and physical-chemical elements.
If the ecological status is high, the assessment of hydromorphological characteristics is foreseen to support the biological data, through the application of two indices: the "Indice di Qualità Morfologico" (Morphological Quality Index - IQM) and the "Indice di Alterazione delRegime Idrologico" (Hydrological Regime Alteration Index – IARI) (Rinaldi et al. 2009).
For the river stretchs defined as Reference Sites, it must be evaluated also the riparian habitats conditions, through the definition of the Habitat Quality Index (IQH).
In Italy the reference document for the classification is the draft of the Decree "Criteri tecnici per la classificazione dello stato dei corpi idrici superficiali, per la modifica delle norme tecniche del decreto legislativo 3 aprile 2006, n. 152, recante norme in materia ambientale".

On the basis of Ecological Status Quality extracted from the monitoring data - SECA Index - for the years 2004-2008, ARPA had made a preliminary assessment of watercourses at risk of not achieving the targets provided by the WFD [**Image 11** and **Table 8**].

Image 11 – Map of monitoring network of Dora Baltea river Basin until 2008 and first risk analysis [extracted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

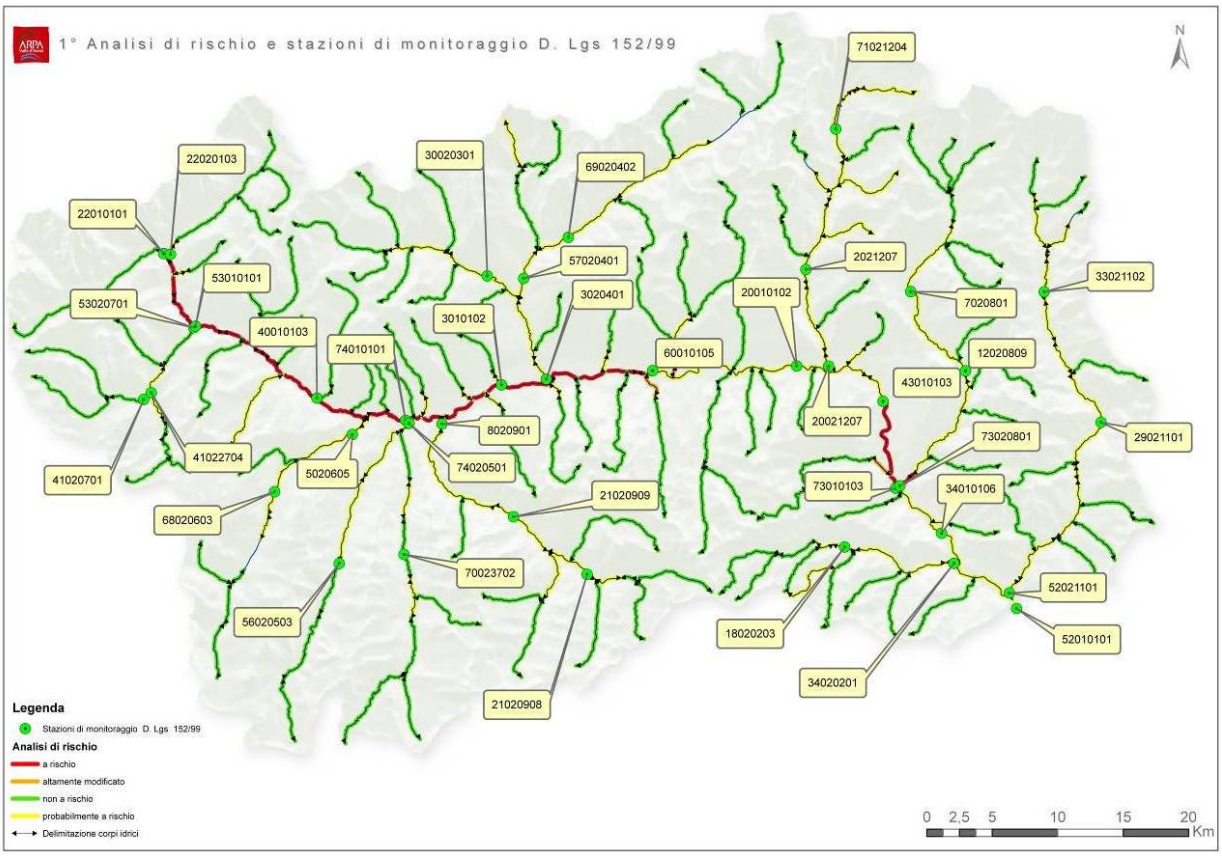


Table 8 - Monitoring network of Dora Baltea river Basin until 2008 and first risk analysis [extracted and modified from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

CODE	RIVER	SECA 2004	SECA 2005	SECA 2006	SECA 2007	SECA 2008
30020301	Artanavaz	high	good	good	good	good
18020203	Ayasse	good	high	high	high	high
34020201	Ayasse	good	good	high	high	good
03020401	Buthier	sufficient	sufficient	good	good	good

57020401	Buthier	good	good	good	good	good
69020402	Buthier	good	good	good	good	good
03010102	Dora Baltea	sufficient	sufficient	sufficient	good	sufficient
20010102	Dora Baltea	good	good	good	good	good
22010101	Dora Baltea	good	good	good	good	good
34010106	Dora Baltea	good	good	good	good	good
40010103	Dora Baltea	sufficient	sufficient	sufficient	sufficient	sufficient
43010103	Dora Baltea	sufficient	good	sufficient	good	good
52010101	Dora Baltea	good	good	good	good	good
53010101	Dora Baltea	sufficient	sufficient	sufficient	sufficient	sufficient
60010105	Dora Baltea	good	good	good	good	sufficient
73010103	Dora Baltea	good	good	good	good	sufficient
74010101	Dora Baltea	sufficient	sufficient	sufficient	sufficient	sufficient
22020103	Dora di Ferret	good	good	good	high	good
53020701	Dora di La Thuile	good	good	good	good	good
56020503	Dora di Rhemes	good	good	good	good	good
74020501	Dora di Rhemes	good	good	good	good	good
05020605	Dora di Valgrisenche	high	high	good	high	good
68020603	Dora di Valgrisenche	good	good	good	good	good
41020701	Dora di Verney	high	good	good	high	high
07020801	Evançon	sufficient	good	sufficient	sufficient	good
12020809	Evançon	good	good	good	good	good
73020801	Evançon	sufficient	sufficient	good	sufficient	sufficient
08020901	Grand'Eyvia	sufficient	sufficient	good	sufficient	good
21020908	Grand'Eyvia	high	good	high	high	good
21020909	Grand'Eyvia	good	good	good	good	good
29021101	Lys	sufficient	good	good	good	good
33021102	Lys	good	good	good	good	good
52021101	Lys	good	good	good	good	good
02021207	Marmore	sufficient	good	high	good	good
20021201	Marmore	good	good	good	good	good
71021204	Marmore	sufficient	good	high	good	good
70023702	Savara	good	good	good	good	good
41022704	Torrente Rutor	good	high	high	high	good

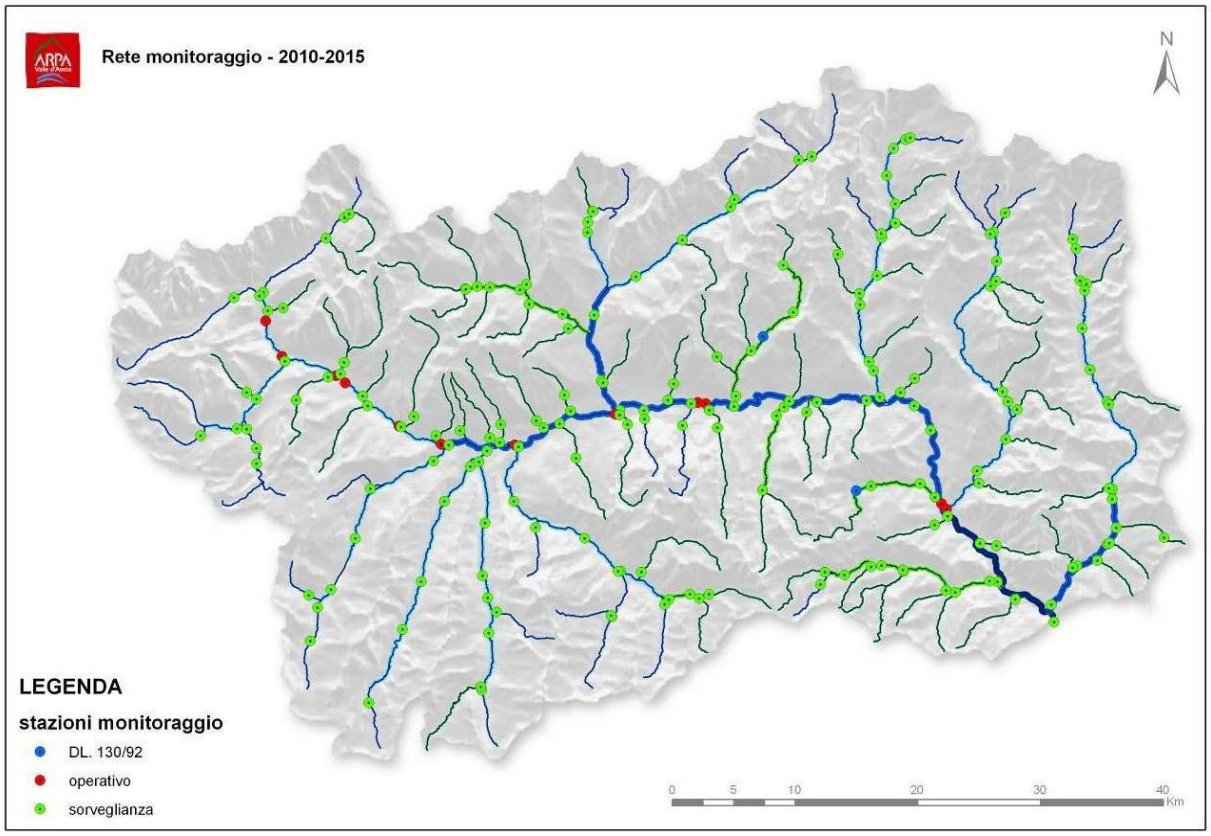
In compliance with the Directive 2000/60/EC the monitoring of watercourses has been extended to a more biological elements (diatoms, macrophytes and ichthyofauna) with the application of new investigative methods and the variation of other (i.e. macrobenthos). In 2008, ARPA has identified 20 watercourses on which to place a monitoring station for testing new investigation methods [**Image 12**]. 13 of these monitoring stations are identified as the reference type sites for the WFD typologies and called “network core”.
In all monitoring sites investigated according to the APAT biological communities sampling protocols were:

- Macrobenthos;
- Diatoms;
- Macrophytes.

For the water bodies quality classification, the WFD provides, monitoring of the following:

- **Biological elements**
  composition and abundance of aquatic flora (macrophytes and diatoms);
  composition and abundance of benthic macroinvertebrates;
  composition and abundance of fish;
- **Hydromorphological elements** supporting the biological elements;
- **Chemical and physical elements** supporting the biological elements;
- **Specific pollutants**.

Image 12 – Monitoring stations for testing new investigation methods [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



On the basis of risk analysis and monitoring of the typologies defined by the WFD has been defined the final monitoring network for 2010 and provisional for the period 2011-2015. ARPA had identified in total 202 monitoring stations [**Image 13**] distributed as follows:

- **12 Operational monitoring sites**
- **188 Surveillance monitoring sites**: in 14 of this monitoring stations it is also applied the monitoring system foreseen for classification and assessment of surface waters conformity suitable to salmonid and cyprinid fish (D.lgs. 152/06 - Appendix 2 Part III - Section B)
- **2 stations monitored exclusively under the D.lgs. mentioned above**.

As required by the WFD in all monitoring stations are performed monitoring of biological components [**Table 9**]:

- In all stations of the network will carry out monitoring surveys every six months for macrobenthos and diatoms and every three months for physic-chemical parameters;
- In 13 monitoring stations called "network core" the biomonitoring is extended, with the same frequency, even to aquatic macrophytes;
- As regards the ichthyofauna the monitoring will probably start in 2011.

Image 13 – Final monitoring network for 2010 [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

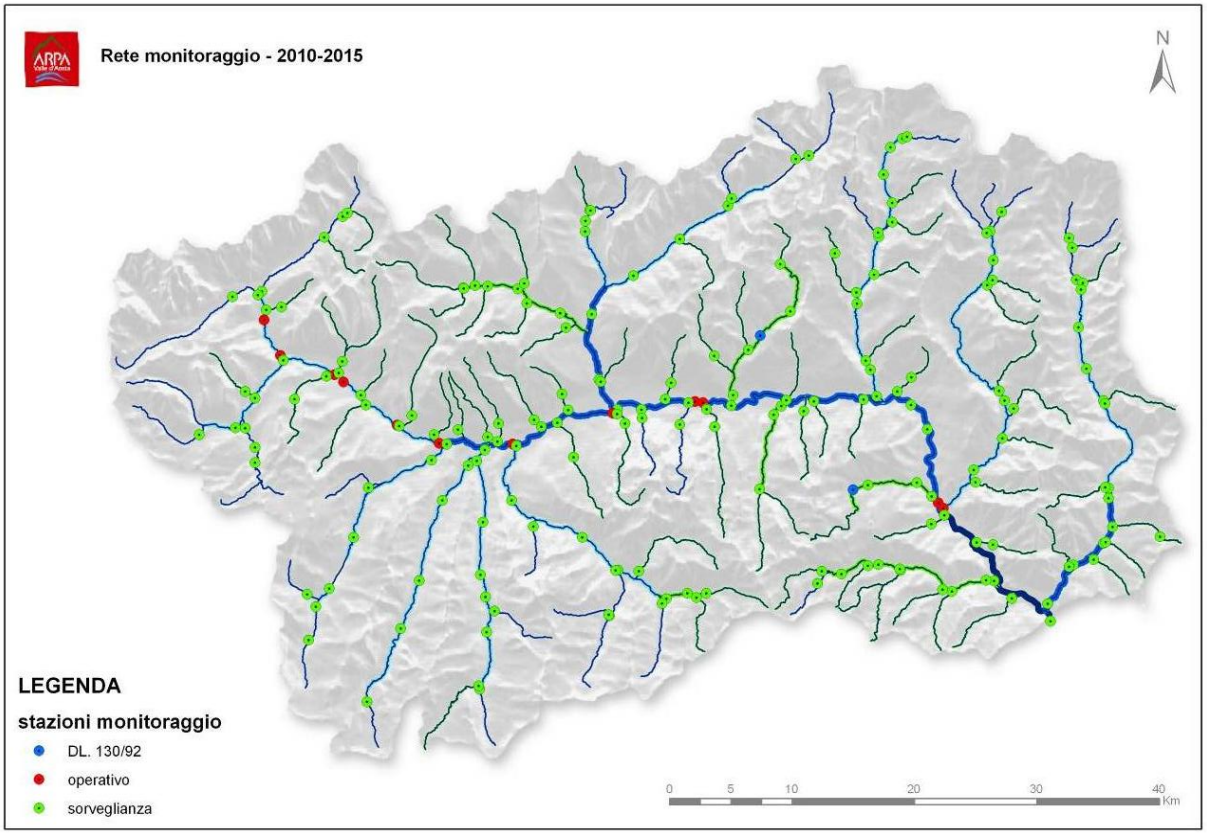


Table 9 - Monitoring network of Dora Baltea river basin [extracted and modified from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

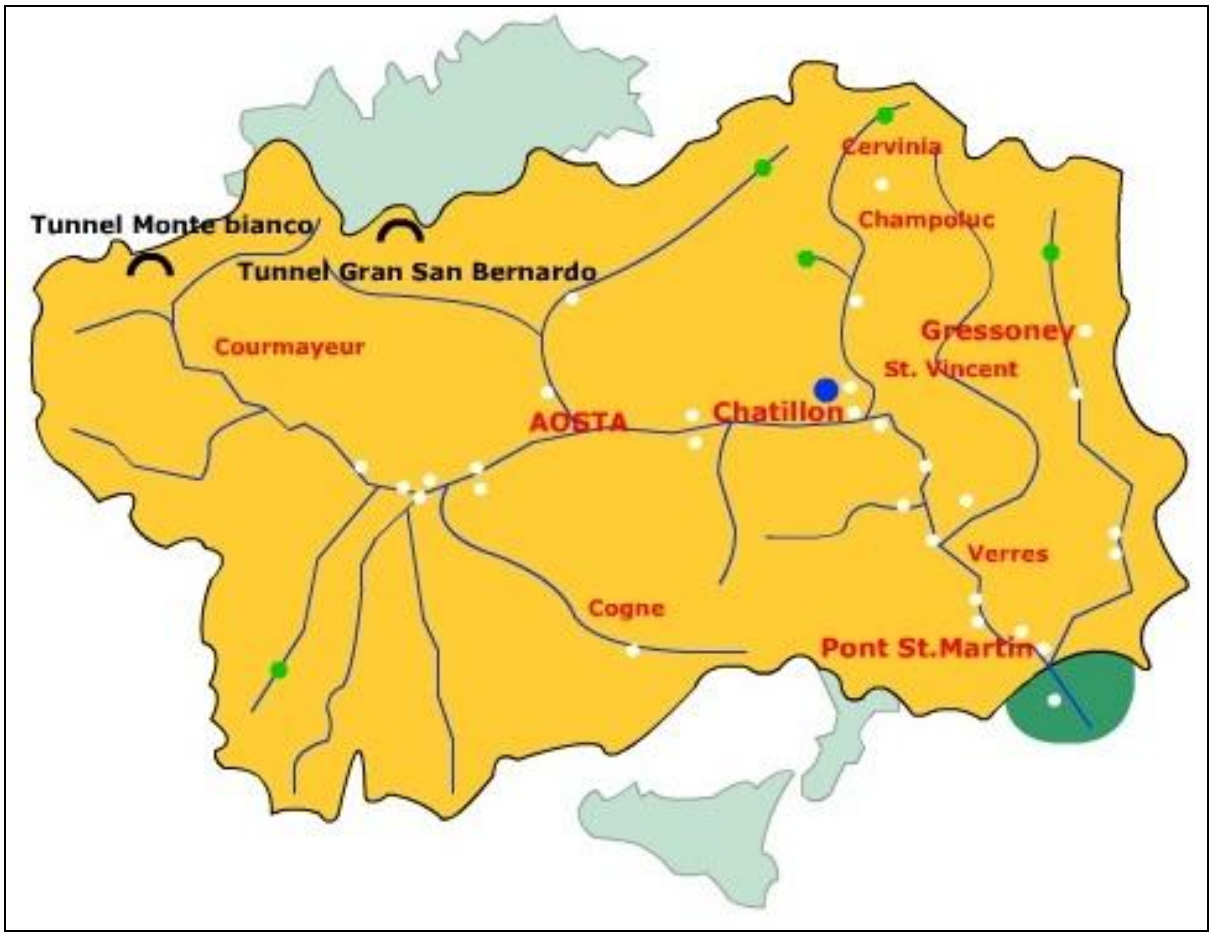
MONITORING TYPE	SURVEILLANCE	SURVEILLANCE NETWORK CORE	OPERATIONAL
Macrobenthos	X	X	X
Diatoms	X	X	X
Macrophytes		X	
Physic-chemical paramenters*	X	X	X
FREQUENCY	[three-monthly*] six-monthly	[three-monthly*] six-monthly	[three-monthly*] six-monthly

3. Water uses

3.1 Hydropower exploitation

In the Dora Baltea river basin there are 148 HP plants different for typology and power installed [data source Aosta Valley Region - data uploaded to 2009]. Of these 31 are of Aosta Valley Water Company [CVA] property [**Image 14**] and 117 are private.

Image 14 – Aosta Valley Water Company HP plants [extracted from Aosta Valley Water Company website].



The efficient power of the installed plants on the entire basin is 900 MW: 830 MW for CVA plants and 70 MW for private investment over 70 kW [data source: Aosta Valley Regional Energy Plan, RAVA – 2003].

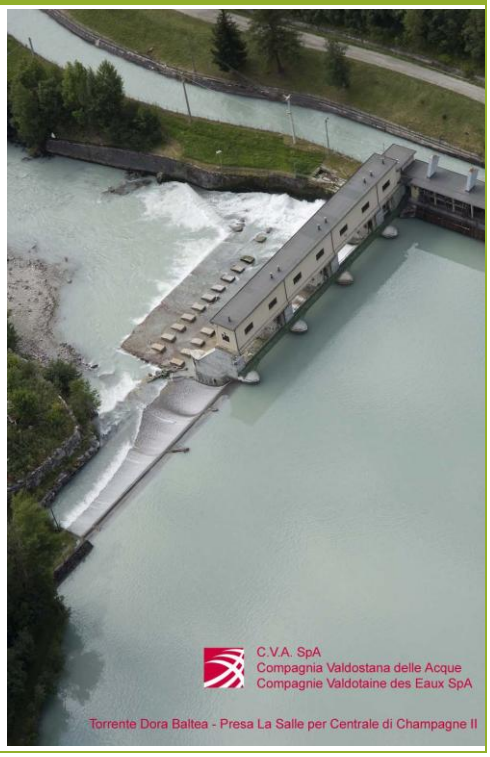
Annual energy production at river basin scale

The annually hydropower produced throughout the Dora Baltea river basin amounted to 2609 GWh [data source: Aosta Valley Regional Energy Plan, RAVA – 2003].

Number location and power installed of HP plants specifically related to the river portion interested by MCA test

In the Dora Baltea river basin the MCA will be applied to 8 different existing CVA plants located along the Dora Baltea river with the aim to detect the MIF quantity to release from every withdrawal considered.

The HP plants considered along the Dora Baltea river are shown below. For each HP plant is available a short description including number, location and power installed, and a essentially photographic documentation.

LA SALLE INTAKE			IMAGE [PHOTO: S. VENTURINI]
Code	CVA-C-LAS		
Property	CVA		
Plant	Champagne II		
Typology	with reservoir		
Other intakes	yes		
Power installed	27	MW	
Energy yearly production average	151	GWh	
Year building	1938		

MECOSSE INTAKE			IMAGE [PHOTO: S. VENTURINI]
Code	CVA-C-MEC		
Property	CVA		
Plant	Grand Eyvia		
Typology	with reservoir		
Other intakes	Yes		
Power installed	1.6	MW	
Energy yearly production average	9	GWh	
Year building	1921		

SARRE INTAKE			IMAGE [PHOTO: S. VENTURINI]
Code	CVA-C-SAR		
Property	CVA		
Plant	Quart		
Typology	run-of		
Other intakes	Yes		
Power installed	40	MW	
Energy yearly production average	178	GWh	
Year building	1958		

NUS INTAKE			IMAGE [PHOTO: S. VENTURINI]
Code	CVA-C-NUS		
Property	CVA		
Plant	Saint Clair		
Typology	run-of		
Other intakes	No		
Power installed	31	MW	
Energy yearly production average	180.01	GWh	
Year building	1950		

SAINT CLAIR INTAKE			IMAGE [PHOTO: S. VENTURINI]
Code	CVA-C-SCL		
Property	CVA		
Plant	Montjovet		
Typology	run-of		
Other intakes	No		
Power installed	50	MW	
Energy yearly production average	221	GWh	
Year building	1994		

MONTJOVET INTAKE			IMAGE [PHOTO: S. VENTURINI]
Code	CVA-A-MON		
Property	CVA		
Plant	Hone I		
Typology	run-of		
Other intakes	Yes		
Power installed	18.5	MW	
Energy yearly production average	118.44	GWh	
Year building	1947		

BARD INTAKE			IMAGE [PHOTO: S. VENTURINI]
Code	CVA-B-BAR		
Property	CVA		
Plant	Bard		
Typology	run-of		
Other intakes	No		
Power installed	3.2	MW	
Energy yearly production average	25.17	GWh	
Year building	1941		

QUINCINETTO II INTAKE			IMAGE [PHOTO: S. VENTURINI]
Code	CVA-B-PSM		
Property	CVA		
Plant	Quincinetto		
Typology	run-of		
Other intakes	No		
Power installed	22	MW	
Energy yearly production average	115	GWh	
Year building	1988		

3.2 Farming

The data of the 5th General Census of Agriculture [ISTAT, 5th General Census of Agriculture - Presentation of final data: Valle d'Aosta, 2003], reveal the presence of 6.595 farms, with a total area of 190.834 hectares, the 58% of the region.
The micro-businesses with less than 5 hectares dominate making up the 82% of the total while large farms over 100 hectares, representing the 3%. The prevailing type is family direct management.
The culture more frequent in the Aosta Valley region is the permanent grassland and pasture, related to breeding. Woody crops are represented in particular by fruit trees and vineyards.
The cattle breeding is the most common breeding in the Aosta Valley region with 38,888 heads of cattle and 1.586 farms [data source Aosta Valley Region River Basin Management Plan, 2006].
The water abstractions for irrigation use are 508 [data source Aosta Valley Region River Basin Management Plan, 2006] in which prevail small withdrawals with a capacity lower than 1000 l / s. The seasonal withdrawals significantly prevail on the annual ones, and represent the 89% of the total.

3.3 Factory

With regard to the firms, in the Aosta Valley region the industry is the 6,2% of the productive [date extracted from RAVA elaborations on Infocamere date, 2002] with a prevalence of small and medium enterprises. The enterprise business in the region of Valle d'Aosta and all summary data are available in Chapter 4. "Pressures and impacts related to water uses" section "Factory wastes".

3.4 Waste discharges

The list of waste discharges typologies present in the Aosta Valley region and all summary data are available in Chapter 4. "Pressures and impacts related to water uses" section "Waste discharges".

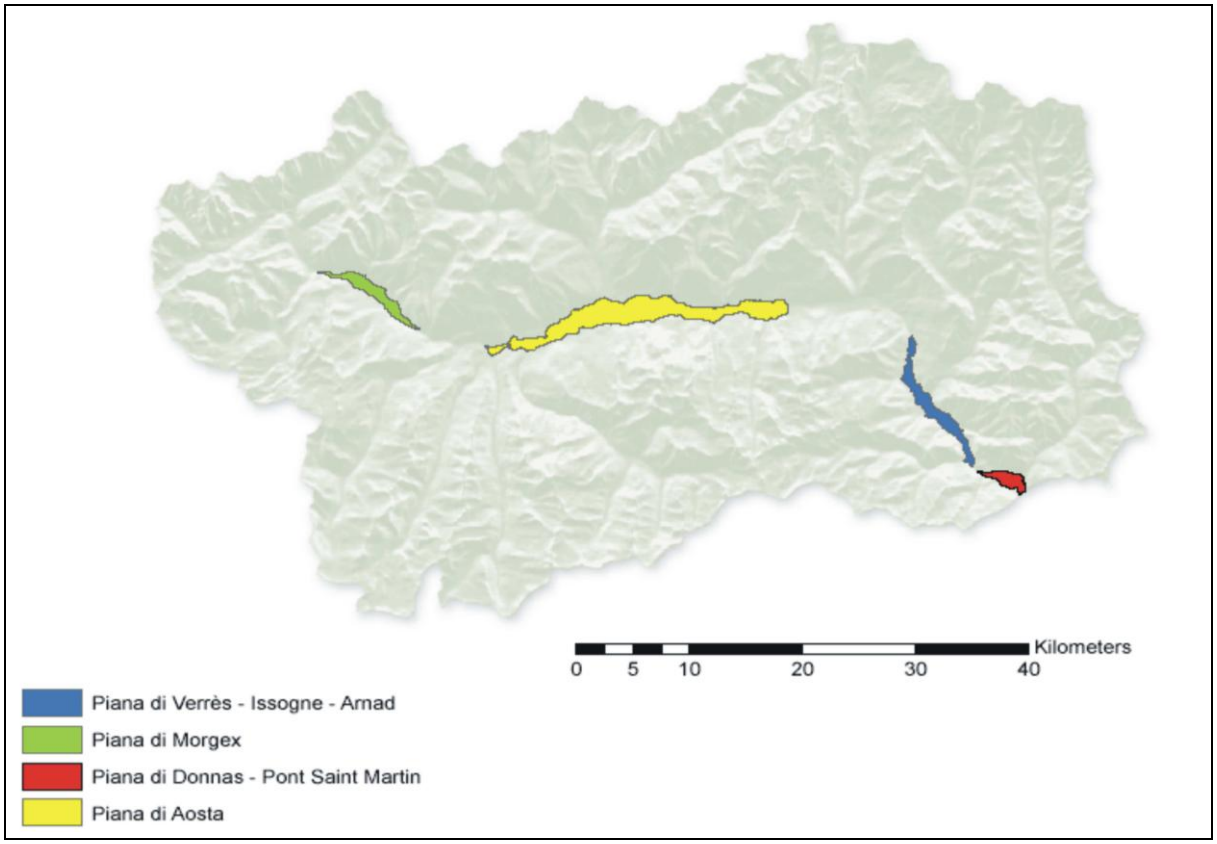
3.5 Drinking water

In the Dora Baltea river basin, the underground water are present in:

- mountain zone - where the water is picked-up by wells;
- valley bottom - where there are water tables, exploited by industrial and drinking wells.

Under the Legislative Decree 152/99, the institutional monitoring of water tables is started in 2003 concerning the four water tables shown below [**Image 15**] with an extension of approximately 60 km^2.
In 2009 two important european Directives [2000/60/CE and 2006/118/CE] have been received with the coming into force of the new Legislative Decree 30/09 about the protection and monitoring of groundwater tables.
In 2003, the Dora Baltea river flows has been analysed (TRIGANON et al., 2003) to highlight the leaks and the contributions existing between the Dora Baltea river and the groundwater tables.
The result of this analysis separates the valley bottom of Dora Baltea river in six sub-zones. In some of these it results evident that the Dora Baltea river feeds the groundwater tables, whereas in others it drains them.
[For further details consult TRIGANON et al., 2003 and “Monitoraggio idrologico nella Regione Valle d’Aosta”, 2010]

Image 15 – Map of groundwater monitoring areas on the Dora Baltea river Basin [extracted from the document "*Monitoraggio idrologico nella Regione Valle d'Aosta*". 2010].



3.6 Touristic fruition

The touristic fruition typologies on the Dora Baltea river basin are numerous:

Naturalistic fruition

The Dora Baltea river basin torrential environment offers numerous opportunities of naturalistic fruition: geomorphologic interest sites such as gorges and ravines, and damp zones with a rich riparian vegetation and wildlife associated with these environments [i.e. insects, amphibians, fish and birds], which attract many visitors and fans every years.

Fishing

The touristic management of fisheries is entrusted by law (R.L. May 10th, 1952, n. 2 – R.L. August 11,1976, n. 34th, R.L. September 2nd, 1996, n. 30) to the Regional Consortium for protection, increase and practice of fishing activities in the Aosta valley region.
The Consortium is the representative body for Aosta Valley region fishermen who become members by paying its dues. The income and assets are composed of the members shares and any contributions of the State and Region (R.L. May 23th, 1973, n. 30).
Also the operations of fish restocking are carried out by the Consortium staff (partly dependent and partly voluntary). Through the voluntary fish guards finally the Consortium monitors the compliance of existing legislation on fisheries both supervisory and fish restocking.
The Consortium also determines the criteria, guidelines and directives for its operation and draw their business plans through the adoption of internal rules.
The fishing regulation in the Aosta Valley region is covered each year through the enactment of the "Fish Calendar" and its attachments by special decree of Farming and Natural Resources councilor.
The "Fish Calendar" defines:

- The opening and closing dates for fishing;
- The equipments and baits permitted and illegal;
- The catches (minimum size, mode and quantitative);
- The surveillance;
- The special fishing arrangements;
- The documents necessary for the fishing;
- The types of permits;
- The cost of permits;
- The specific prohibitions.

[For further details consult the Aosta Valley River Basin Management Plan, 2006]

Water Sport

In the Dora Baltea river basin there are numerous different water sports that every year attract thousands of tourists and fans: rafting, canoeing, kayaking, hydro-speeding and canyoning. The most interesting paths along which can be applied different disciplines are represented in the next image [**Image 16** and **Image 17**].

Image 16 – Map of water sport distribution on the Dora Baltea river Basin [extracted from the Aosta Valley River Basin Management Plan. 2006].

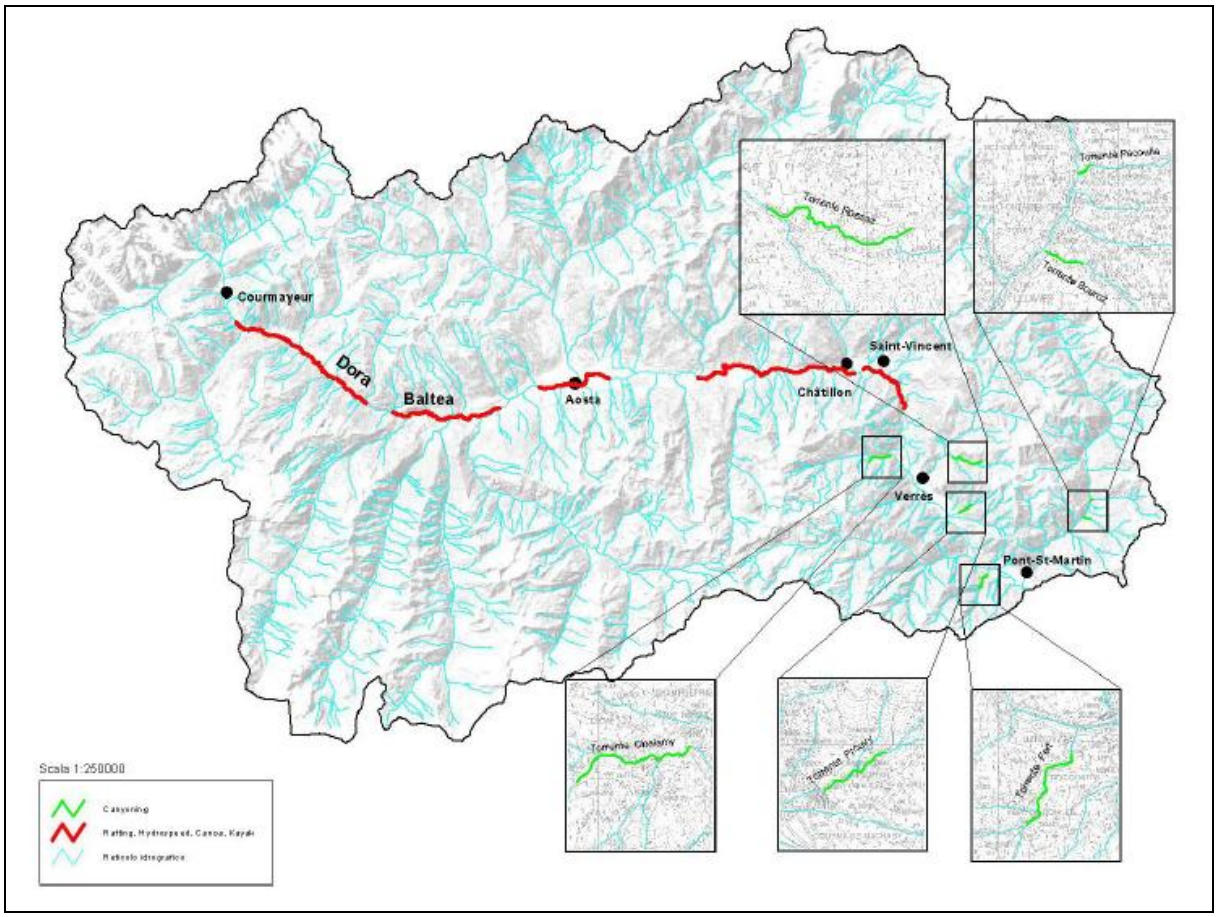


Image 17 – Images of water sport on the Dora Baltea river basin [extracted from the Aosta Valley River Basin Management Plan. 2006].

4. Pressures and impacts related to water uses

4.1 Land use

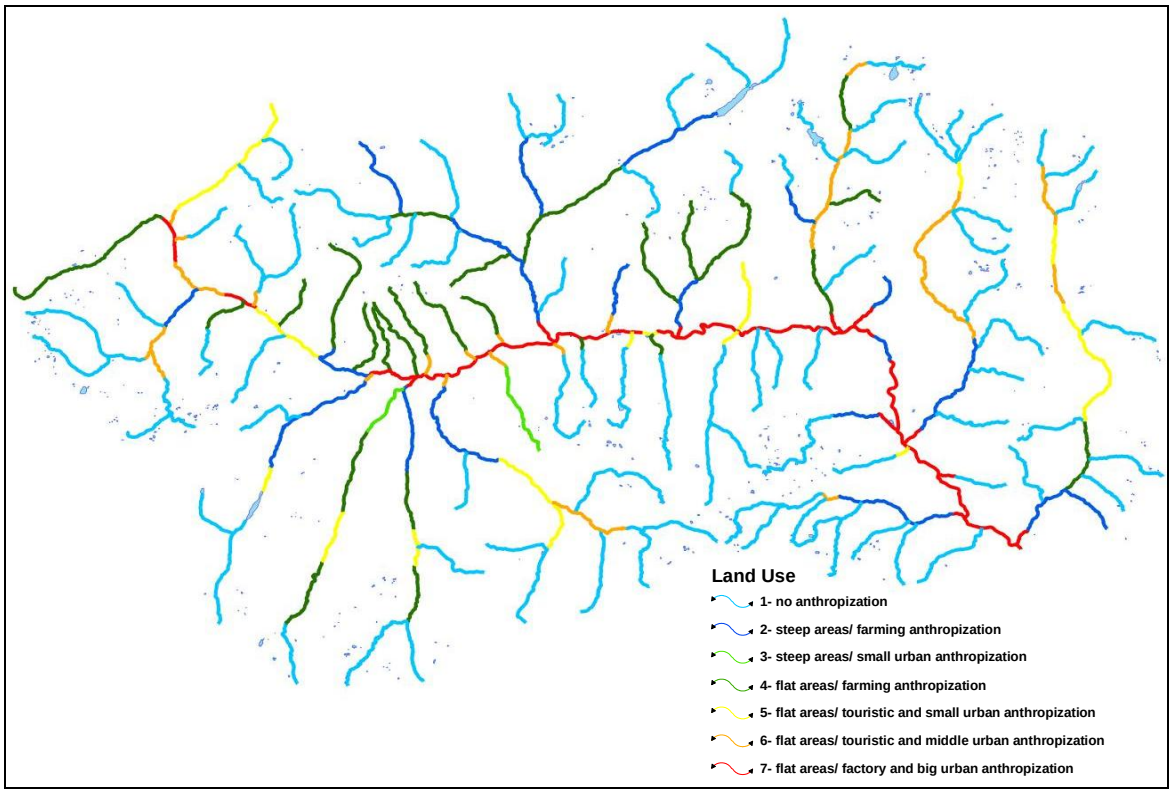
The land use is intended as the land anthropization. In document "*Tipizzazione dei corpi idrici superficiali*" - ARPA - Aosta Valley Region [Draft, 2010], has been created a spread pressure classification based on a scale divided into seven classes. The land use categories are ordered from 1 to 7 in order of increasing anthropization [**Table 10**].

Table 10 – Land use categories [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

LAND USE		PRESSURE VALUE
STEEP AREAS	No anthropization	1
	Farming anthropization	2
	Small urban anthropization	3
FLAT AREAS	Farming anthropization	4
	Touristic and small urban anthropization	5
	Touristic and middle urban anthropization	6
	Factory and big urban anthropization	7

Through the analysis of CTR 1:10.000, aerial photos and through spot checks, ARPA Aosta Valley Region had applied the land use classification to each stream dividing the river where necessary [**Image 18**].

Image 18 – Final monitoring network for 2010 [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



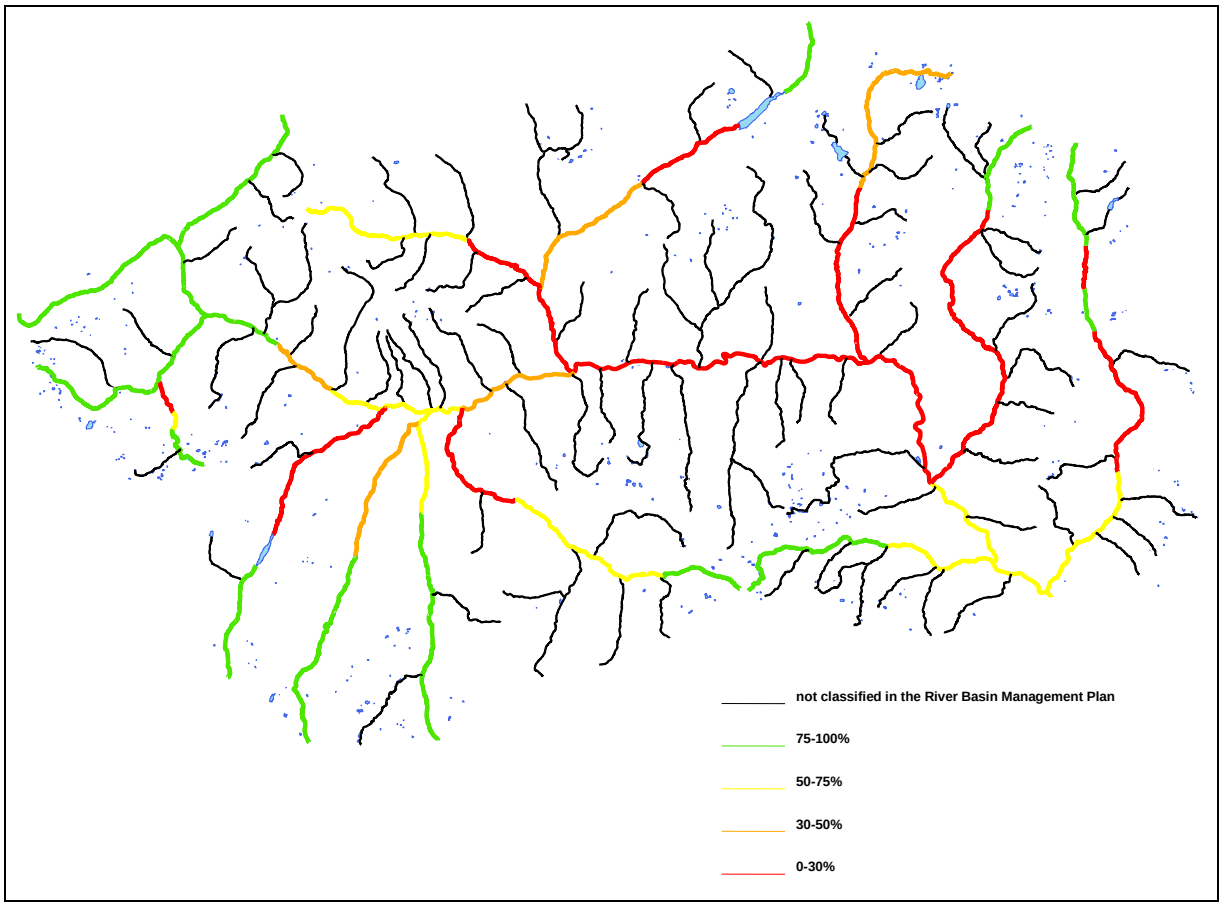
4.2 Water balance

This information processed in the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [2010] from data present in the River Basin Management Plan provides a quantitative information on the degree of water exploitation. The remaining percentages refer to watercourses considered significant under the PTA and have been grouped into 4 classes [**Table 11** and **Image 19**].

Table 11 – Water balance categories [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. 2010].

PERCENTAGE RESIDUAL QUANTITY	CLASS
75 – 100 %	Class 1
50 – 75 %	Class 2
30 – 50 %	Class 3
0 – 30 %	Class 4

Image 19 – Percentage residual quantity of water [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. 2010].



4.3 Waste discharges

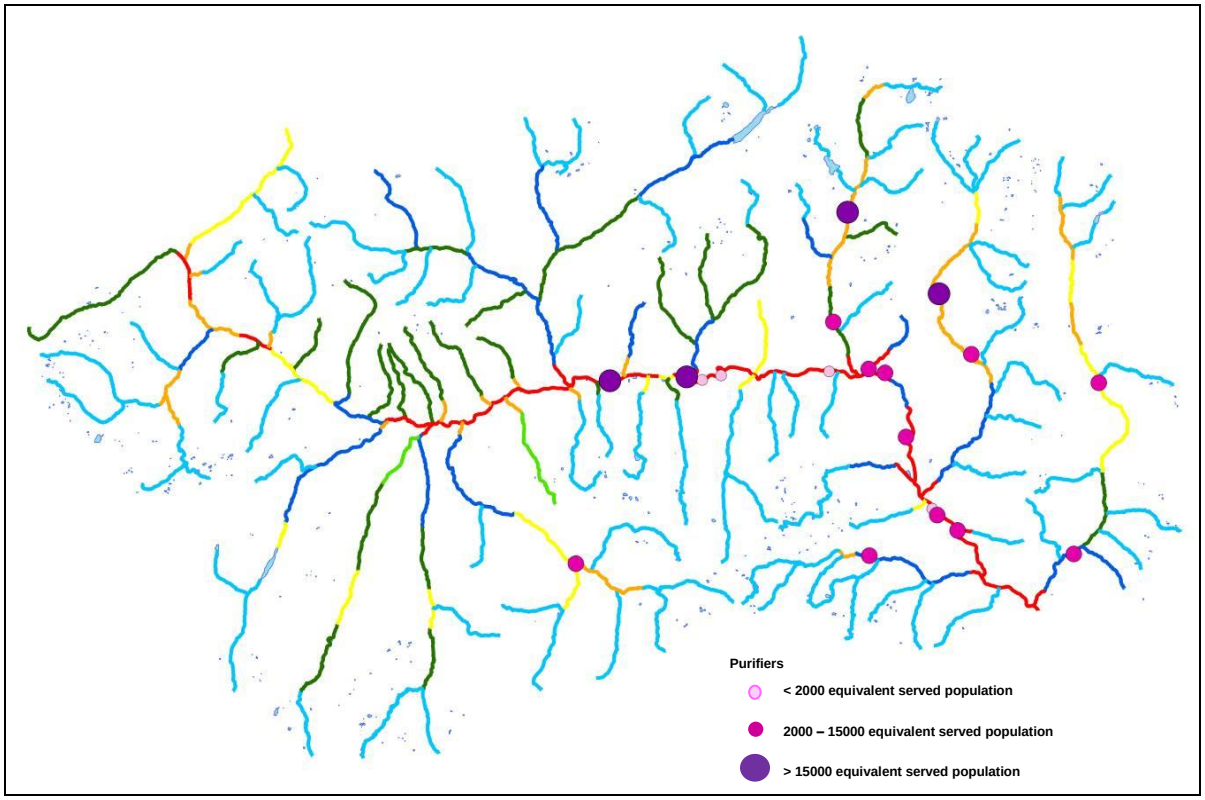
Treatment points

In the Dora Baltea river basin are present 19 treatment plants of which 18 are in operation and one being tested [Gressoney St. Jean]. Most plants are located in urban areas of the valley or at least productive in water bodies characterized by urban pressure more or less widespread. [**Table 12** and **Image 20**].

Table 12 – Treatment point on the Dora Baltea river [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

TOWN	WATERCOURSE	MAXIMUM AUTHORIZED FLOW [L/S]	CLASSIFICATION
Châtillon	Dora Baltea	3,100	< 2000
Nus	Dora Baltea	6,944	< 2000
Fénis	Dora Baltea	41,600	< 2000
Issogne	Dora Baltea	25,000	< 2000
Montjovet	Dora Baltea	27,778	2000 - 15000
Verrès	Dora Baltea	222,222	2000 - 15000
Châtillon	Dora Baltea	50,000	2000 - 15000
Saint Vincent	Dora Baltea	18,519	2000 - 15000
Saint Vincent	Dora Baltea	62,000	> 15000
Brissogne	Dora Baltea	1286,780	> 15000

Image 20 – Treatment points location [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



Factory wastes

In the Dora Baltea river basin are present 33 factory plants with 35 discharges into watercourses (2 plants are equipped with two discharges in the river bed). In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] the factory discharges were classified according to type [**Table 13**].

Most discharges are located in urban areas of the Aosta Valley Region or at least productive in water bodies characterized by urban pressure more or less widespread. The 60% of discharges, corresponding to 21 production plants, located in Dora Baltea urbanized areas [**Table 14** and **Image 21**].

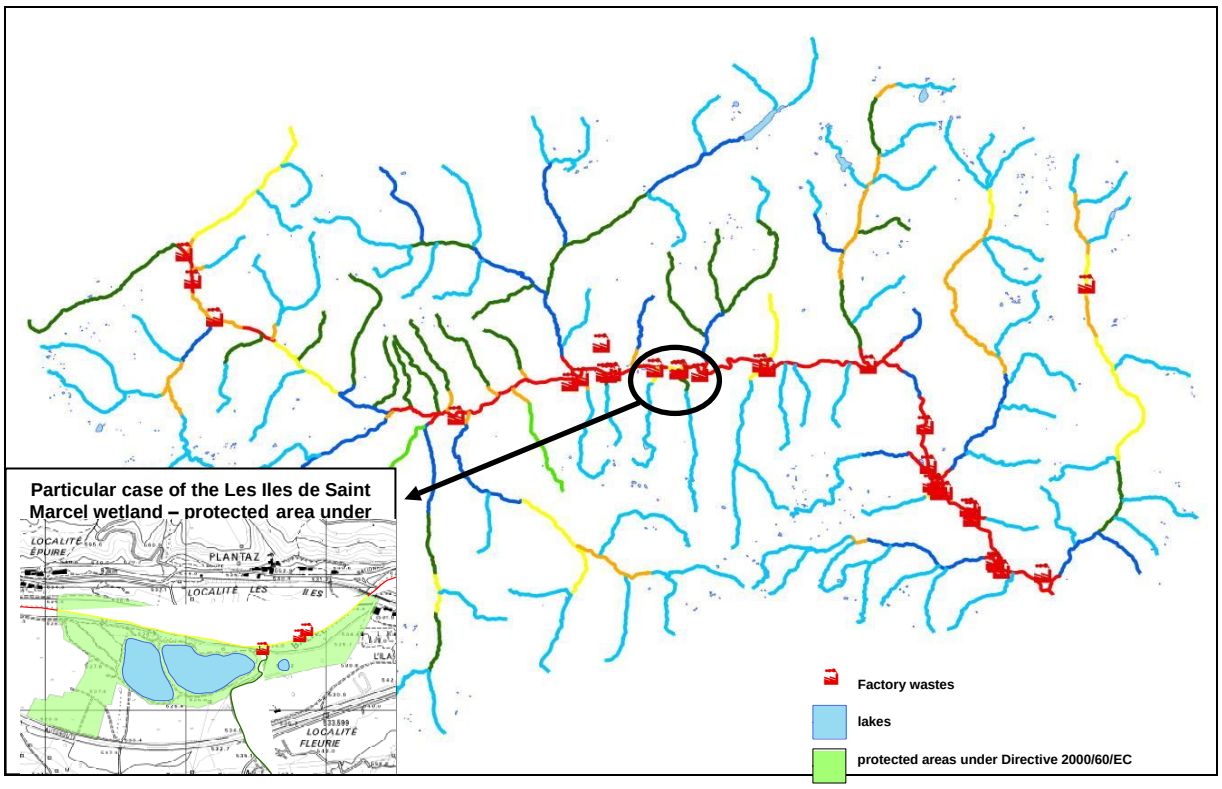
Table 13 – Factory wastes typologies [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

FACTORY WASTES TYPOLOGIES
SEVERAL PRODUCTIONS
CAR WASH AND RINSE OFF
STEEL FACTORIES
MINES
FOOD
INDIRECT WATER COOLING

Table 14 – Factory wastes point on the Dora Baltea river [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

AUTHORIZED SUBJECT	TOWN	WATERCOURSE	MAXIMUM AUTHORIZED FLOW [L/S]	CLASSIFICATION
Cogne Acciai speciali SpA	Aosta	Dora Baltea	333,333	Steel factories – water cooling
Cogne Acciai Speciali Srl	Aosta	Dora Baltea	1111,110	Steel factories – water cooling
Iseco SpA	St. Marcel	Dora Baltea	0,069	Indirect water cooling
Rossignol Ski SpA	Verrayes	Dora Baltea	0,417	Indirect water cooling
Valdostana Carni srl	Pollein	Dora Baltea	3,889	Indirect water cooling
Eltek Plast SpA	Hone	Dora Baltea	5,556	Indirect water cooling
Ge.Ca. Srl	Pollein	Dora Baltea	8,000	Indirect water cooling
C.V.A. SpA	Hone	Dora Baltea	42,222	Indirect water cooling
Mongas Srl	Issogne	Dora Baltea	1,666	Car wash and rinse off
Veralco Srl	Verrès	Dora Baltea	0,003	Several productions
Rossignol Ski SpA	Verrayes	Dora Baltea	0,694	Several productions
Nuova Ceval Srl	Nus	Dora Baltea	1,389	Several productions
Verrès SpA	Verrès	Dora Baltea	22,222	Several productions
Heineken Italia S.p.A.	Pollein	Dora Baltea	36,111	Several productions and water cooling
Daniotti Annamaria e Daniotti Roberto Snc	Donnas	Dora Baltea	0,231	Several productions – car wash and rinse off
SAVDA SpA	Courmayeur	Dora Baltea	0,555	Several productions – car wash and rinse off
M.P.I. SpA	Verrès	Dora Baltea	22,000	Several productions – car wash and rinse off
Verdi Alpi Srl	St. Marcel	Dora Baltea	0,030	Several productions and mines
Rival Srl	Nus	Dora Baltea	1,111	Several productions and mines
Edil Scavi Monte Bianco Srl	Courmayeur	Dora Baltea	3,722	Several productions and mines
I.C.F. Srl	Verrayes	Dora Baltea	3,889	Several productions and mines
Impresa Mochettaz Srl	Brissogne	Dora Baltea	8,333	Several productions and mines
Euro Monti 2033 Srl	Montjovet	Dora Baltea	25,000	Several productions and mines
Cave Chavonne Srl	St. Pierre	Dora Baltea	30,000	Several productions and mines

Image 21 – Factory wastes point on the Dora Baltea river basin [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



Cesspools

In the Dora Baltea river basin are present 201 cesspools. In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] the impact linked to Imhoff cesspools was assessed on two levels of pressure: the pressure due to the single cesspool and the pressure related to the Imhoff density per km. The pressure related to the single cesspool was assessed by classifying the Imhoff in 3 classes in function of the maximum capacity allowed [**Table 15**, **Table 16** and **Image 22**].

Table 15 – Imhoff typology [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

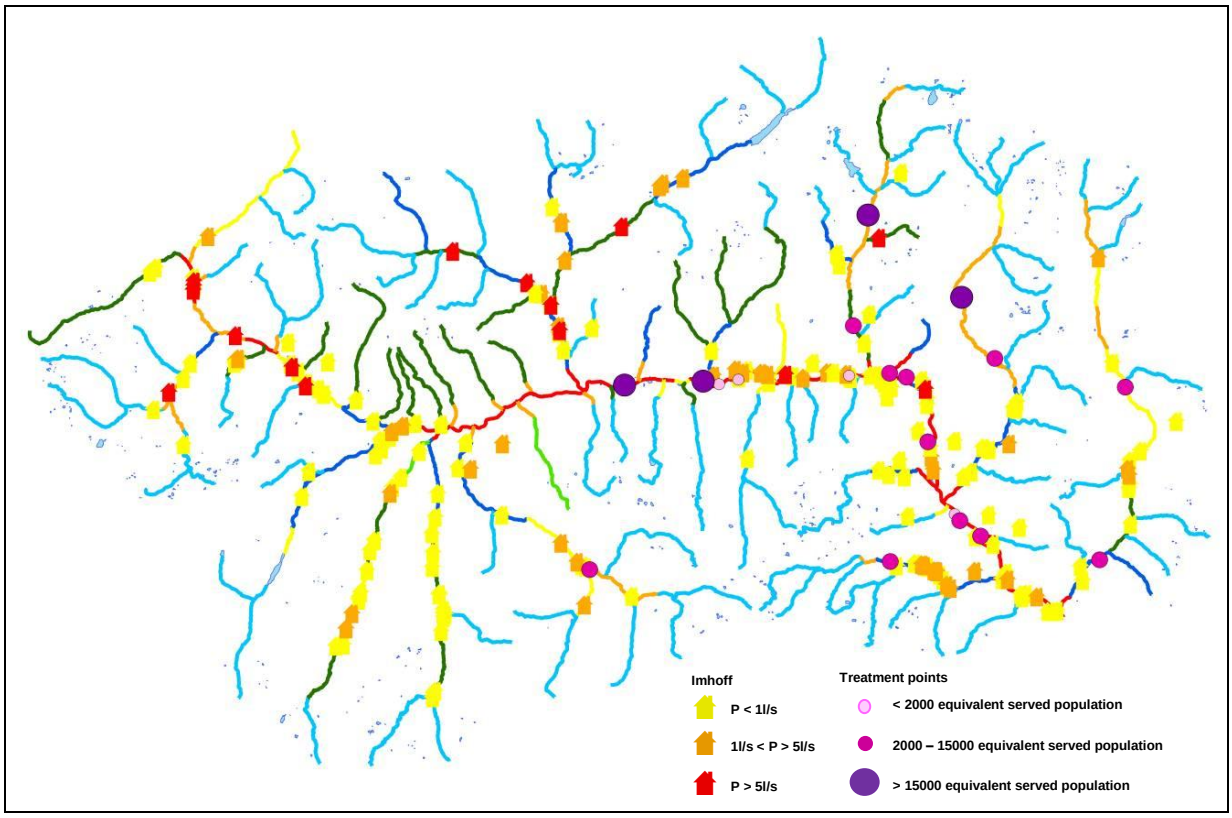
IMHOFF TYPOLOGY	MAXIMUM AUTHORIZED FLOW [L/S]
Small	< 1
Medium	1 - 5
Big	> 5

Table 16 – Cesspools on the Dora Baltea river [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

AUTHORIZED SUBJECT	TOWN	WATERCOURSE	MAXIMUM AUTHORIZED FLOW [L/S]	CLASSIFICATION
Chambave e Verrayes mayors	Chambave	Dora Baltea	30,000	>5
Comunità Montana Valdigne - Mont Blanc president	La Salle	Dora Baltea	28,700	>5
Comunità Montana Valdigne - Mont Blanc president	Courmayeur	Dora Baltea	22,9	>5
Mayor	La Salle	Dora Baltea	12,290	>5

Comunità Montana Valdigne - Mont Blanc president	Courmayeur	Dora Baltea	6,940	>5
Comunità Montana Valdigne - Mont Blanc president	Courmayeur	Dora Baltea	6,900	>5
Comunità Montana Valdigne - Mont Blanc president	Morgex	Dora Baltea	5,860	>5
Mayor	Chambave	Dora Baltea	4,300	1-5
Mayor	Nus	Dora Baltea	4,167	1-5
Mayor	Verrayes	Dora Baltea	3,000	1-5
Mayor	Nus	Dora Baltea	2,778	1-5
Mayor	Nus	Dora Baltea	2,778	1-5
Mayor	Nus	Dora Baltea	2,778	1-5
Mayor	Hone	Dora Baltea	2,600	1-5
Mayor	Arvier	Dora Baltea	2,000	1-5
Mayor	Pontey	Dora Baltea	1,700	1-5
Mayor	Champdepraz	Dora Baltea	1,650	1-5
Mayor	Champdepraz	Dora Baltea	1,650	1-5
Mayor	Montjovet	Dora Baltea	1,500	1-5
Mayor	Chambave	Dora Baltea	1,388	1-5
Mayor	Bard	Dora Baltea	1,120	1-5
Mayor	Donnas	Dora Baltea	1,040	1-5
Mayor	Courmayeur	Dora Baltea	0,958	<1
Mayor	Hone	Dora Baltea	0,900	<1
Mayor	Pontey	Dora Baltea	0,800	<1
Mayor	Arnad	Dora Baltea	0,700	<1
Mayor	Avise	Dora Baltea	0,700	<1
Mayor	Courmayeur	Dora Baltea	0,700	<1
Mayor	Fénis	Dora Baltea	0,690	<1
Mayor	La Salle	Dora Baltea	0,650	<1
Mayor	Pontey	Dora Baltea	0,640	<1
Mayor	La Salle	Dora Baltea	0,630	<1
Mayor	La Salle	Dora Baltea	0,550	<1
Mayor	Arnad	Dora Baltea	0,520	<1
Mayor	La Salle	Dora Baltea	0,520	<1
Mayor	Courmayeur	Dora Baltea	0,500	<1
Mayor	Courmayeur	Dora Baltea	0,319	<1
Mayor	Donnas	Dora Baltea	0,280	<1
Mayor	Montjovet	Dora Baltea	0,250	<1
Mayor	Pont St. Martin	Dora Baltea	0,200	<1
Mayor	Fénis	Dora Baltea	0,170	<1
Mayor	La Salle	Dora Baltea	0,170	<1
Mayor	Arvier	Dora Baltea	0,100	<1
Mayor	La Salle	Dora Baltea	0,100	<1
Mayor	St. Denis	Dora Baltea	0,080	<1
Mayor	Bard	Dora Baltea	0,070	<1
Mayor	Donnas	Dora Baltea	0,070	<1
Mayor	Chatillon	Dora Baltea	0,050	<1
Mayor	Pont St. Martin	Dora Baltea	0,030	<1
Mayor	Chatillon	Dora Baltea	0,010	<1

Image 22 – Cesspools on the Dora Baltea river basin [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



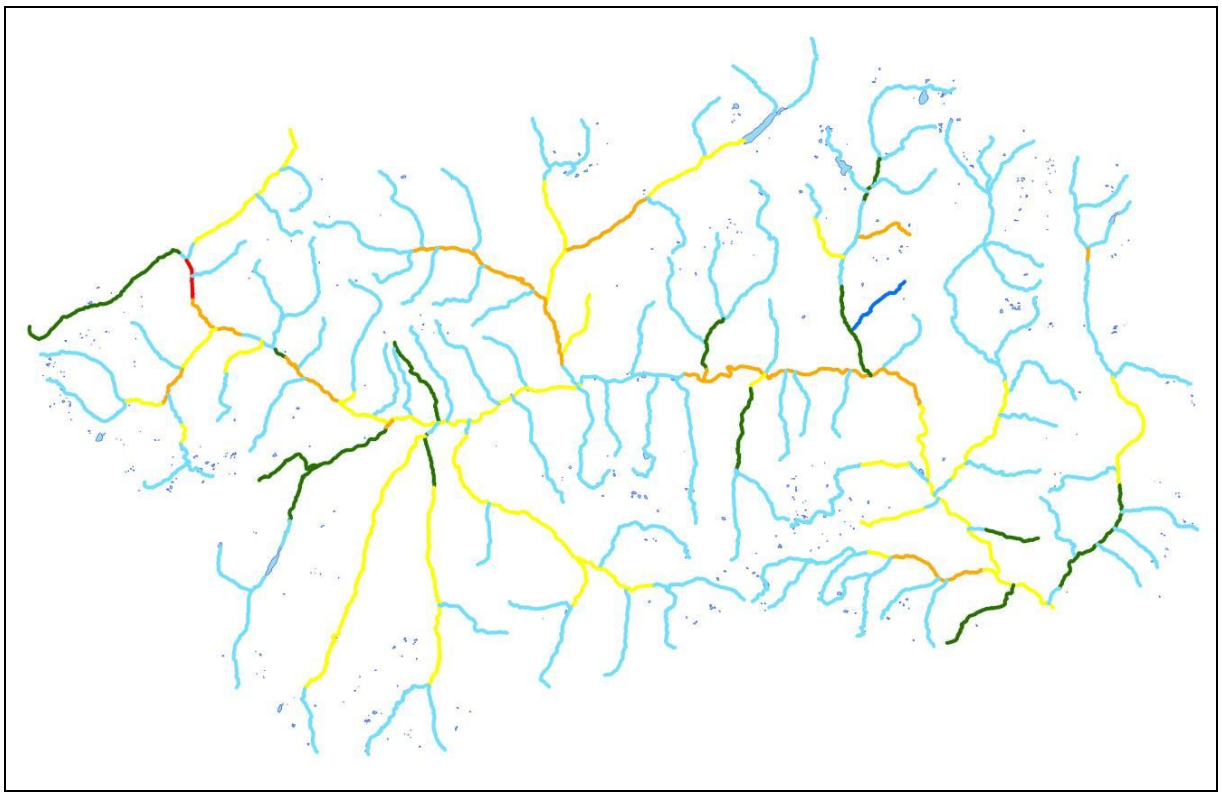
In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] to better assess the overall impact the Imhoff density was determined by calculating for each watercourse the Imhoff flow summation divided by the length of single watercourse in km, obtaining a value expressed in l / s / km. The density values obtained were grouped into seven classes in order of increasing pressure [**Table 17**].

Table 17 – Imhoff pressure classes [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

IMHOFF DENSITY [L/S/KM]	IMHOFF PRESSURE LEVEL	CLASS
0	void	1
0,0001 – 0,001	low	2
0,001 – 0,01	medium	3
0,01 – 0,1	moderate	4
0,1 - 1	moderate - high	5
1 - 10	high	6
> 10	very high	7

Analysis of the data shows how the Imhoff pressure affects more the areas with no treatment plants. The river most impacted is the Dora Baltea in Courmayeur, an area already heavily penalized by the land use [**Image 23**].

Image 23 – Imhoff pressure on the Dora Baltea river basin [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



Untreated civil wastes

In the Dora Baltea river basin are present 43 untreated civil wastes. In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] this impact was assessed on two levels of pressure: the pressure due to the single untreated civil waste and the pressure related to the untreated civil wastes density per km. The pressure related to the single cesspool was assessed by classifying the untreated civil wastes in 4 classes in function of the maximum capacity allowed [**Table 18**, **Table 19** and **Image 24**].

Table 18 – Untreated civil wastes typology [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

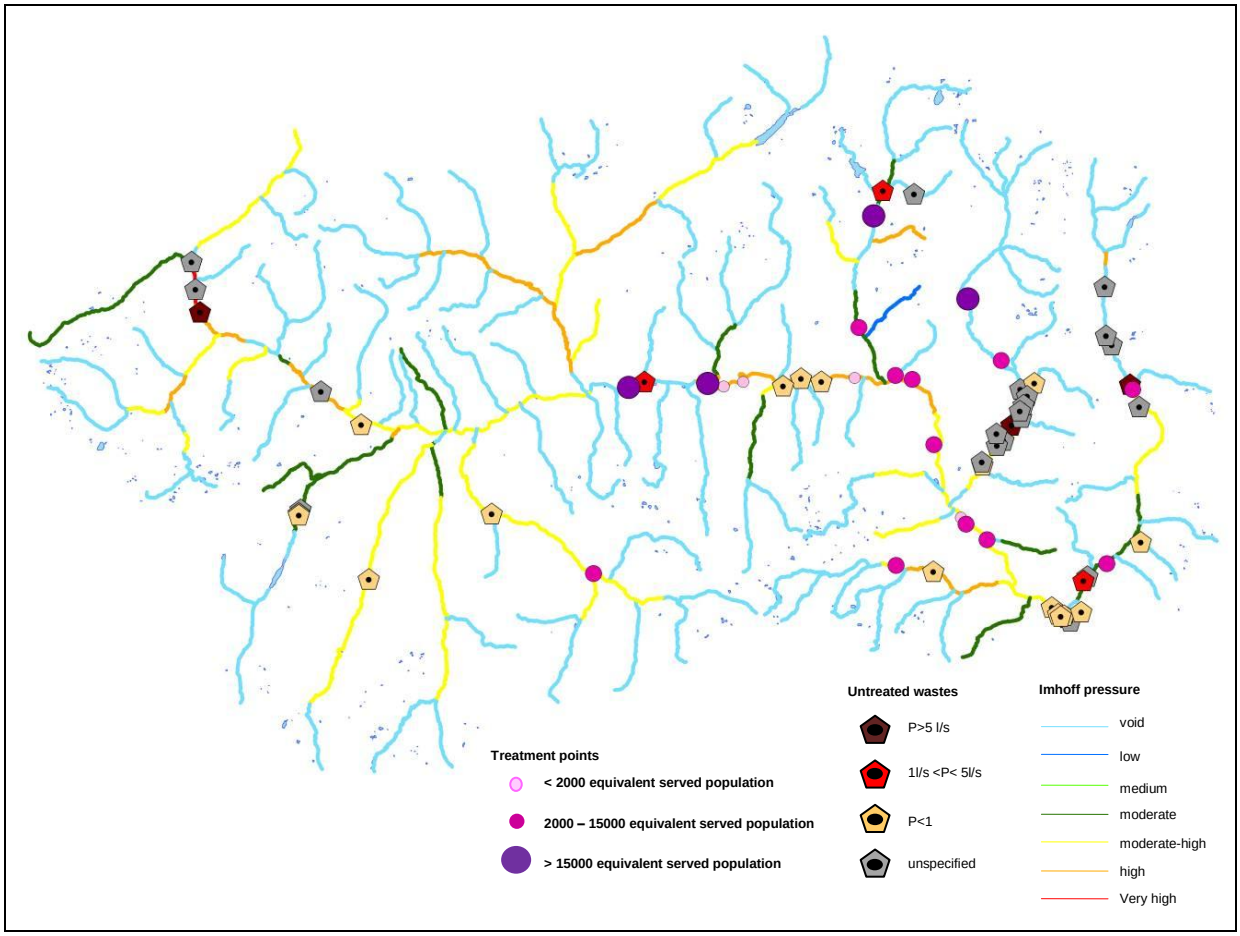
UNTREATED CIVIL WASTES TYPOLOGY	MAXIMUM AUTHORIZED FLOW [L/S]
Small	< 1
Medium	1 - 5
Big	> 5
Unknown	Maximum flow unknown

Table 19 – Untreated civil wastes on the Dora Baltea river [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

AUTHORIZED SUBJECT	TOWN	WATERCOURSE	MAXIMUM AUTHORIZED FLOW [L/S]	CLASSIFICATION
Mayor	Pont St-Martin	Dora Baltea	15,6200	> 5
Mayor	Pré-St-Didier	Dora Baltea	6,9400	> 5
Mayor	Quart	Dora Baltea	2,7700	1- 5
Mayor	Donnas	Dora Baltea	0,9700	<1

Mayor	Chambave	Dora Baltea	0,7700	< 1
Mayor	Avise	Dora Baltea	0,5800	< 1
Mayor	Chambave	Dora Baltea	0,3100	< 1
Mayor	Pont St-Martin	Dora Baltea	0,3100	< 1
Mayor	Pont St-Martin	Dora Baltea	0,2000	< 1
Mayor	Chambave	Dora Baltea	0,0400	< 1
Mayor	Pont St-Martin	Dora Baltea	0,0300	< 1
Soc. OMV	Pont St-Martin	Dora Baltea	0,0120	< 1
Mayor	La Salle	Dora Baltea	0,0000	unspecified
Mayor	Pont St-Martin	Dora Baltea	0,0000	unspecified
Mayor	Courmayeur	Dora Baltea	0,0000	unspecified
Mayor	Courmayeur	Dora Baltea	0,0000	unspecified

Image 24 – Untreated civil wastes on the Dora Baltea river basin [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



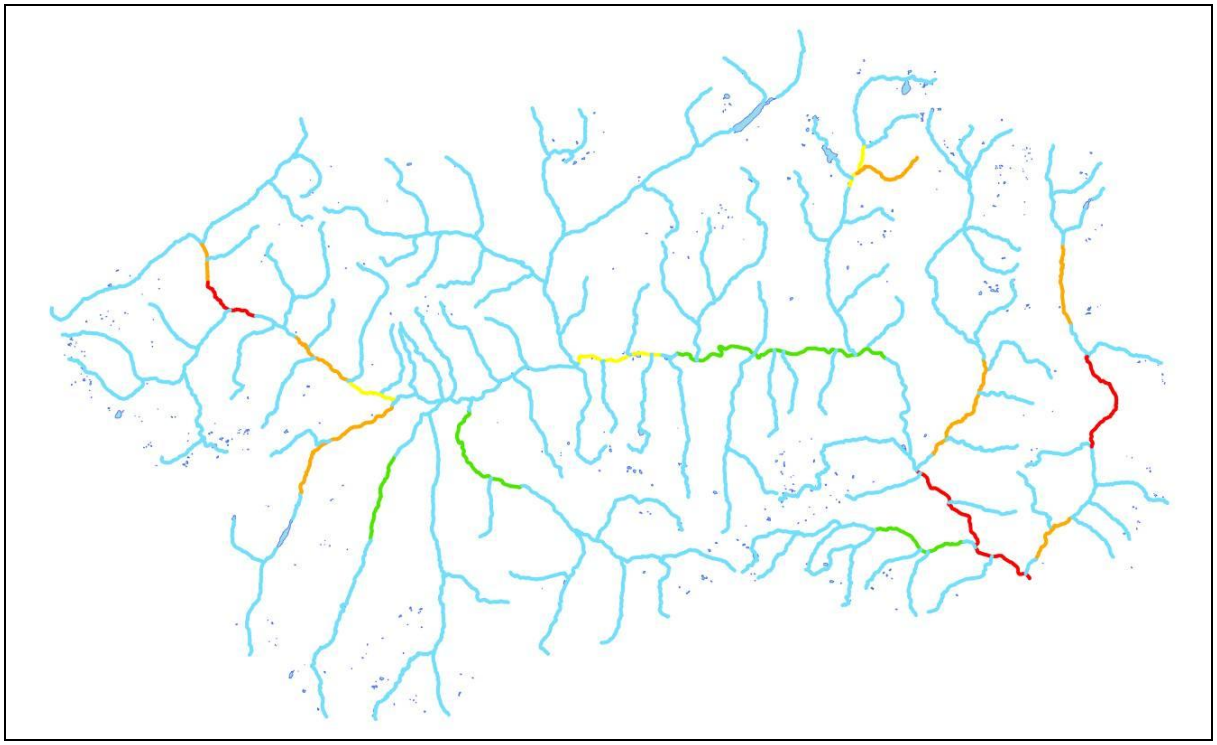
In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] to better assess the overall impact the untreated civil wastes density was determined by calculating for each watercourse the untreated civil wastes flow summation divided by the length of single watercourse in km, obtaining a value expressed in l / s / km. The density values obtained were grouped into 4 classes in order of increasing pressure [**Table 20**].

Table 20 – Untreated civil wastes pressure classes [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

UNTREATED CIVIL WASTES DENSITY [L/S/KM]	PRESSURE LEVEL	CLASS
0	void	0
< 0,1	low	1

0,1 - 1	medium	2
maximum flow unknown	precaution high	3a
> 1	high	3b

Image 25 – Untreated civil wastes on the Dora Baltea river basin [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

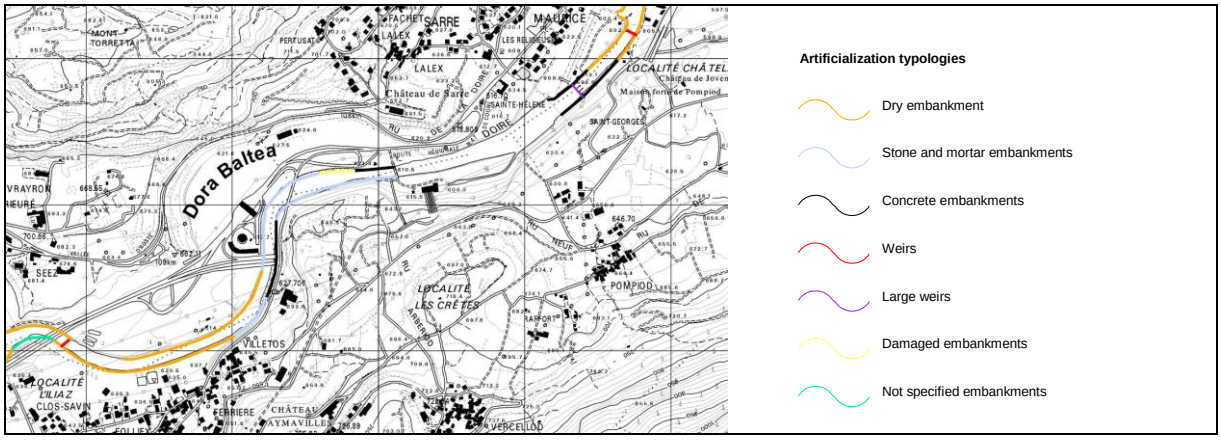


The analysis of the data shows how the untreated civil wastes pressure affects more the areas with no treatment plants. The pressure due to discharges untreated greatest impacts on the Dora Baltea near Courmayeur and near the regional border [**Image 25**].

Morphological alterations

In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010], to determine the impact of morphological alterations was chosen to assess the presence / absence of longitudinal and transverse works on watercourses. The data used refer to the monographs provided by the River Basin Management Plan of Aosta Valley Region [**Image 26**].

Image 26 – Example of morphological alteration representation on the Dora Baltea river basin [extracted from the document: "Tipizzazione dei corpi idrici superficiali" – ARPA – Aosta Valley region. Draft, 2010].



In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010], were evaluated separately:

- Dams or large weirs;
- Weirs;
- Longitudinal alterations including dry, stone and mortar, concrete, damaged and not specified embankments.

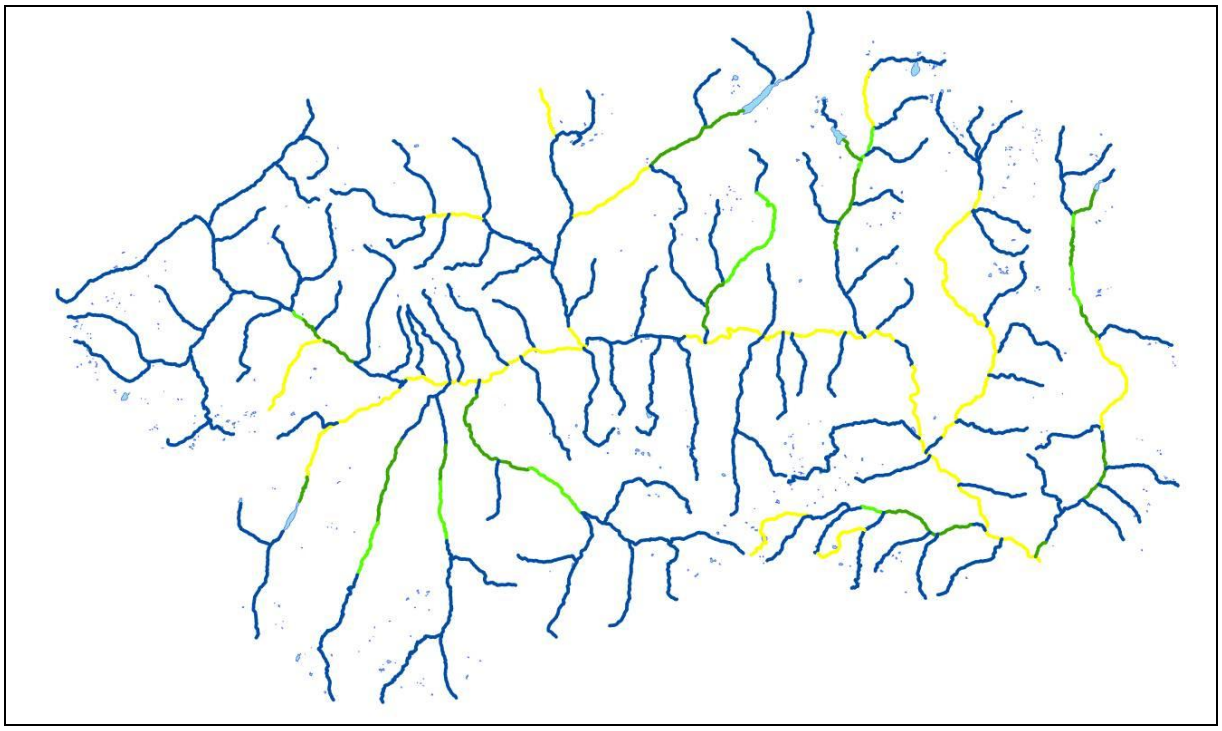
Dams and large weirs

The major barriers identified by the River Basin Management Plan of Aosta Valley Region are 26. In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] had been created a classification to highlight, besides the presence / absence of the work, the location in relation to the river: if the dam is located downstream, upstream or in the middle [**Table 21** and **Image 27**].

Table 21 – Major barriers classification [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

BARRIERS	CODE	COLOUR
No barrier	0	
downstream	1	
upstream	2	
In the middle	3	

Image 27 – Major barriers on the Dora Baltea river basin [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



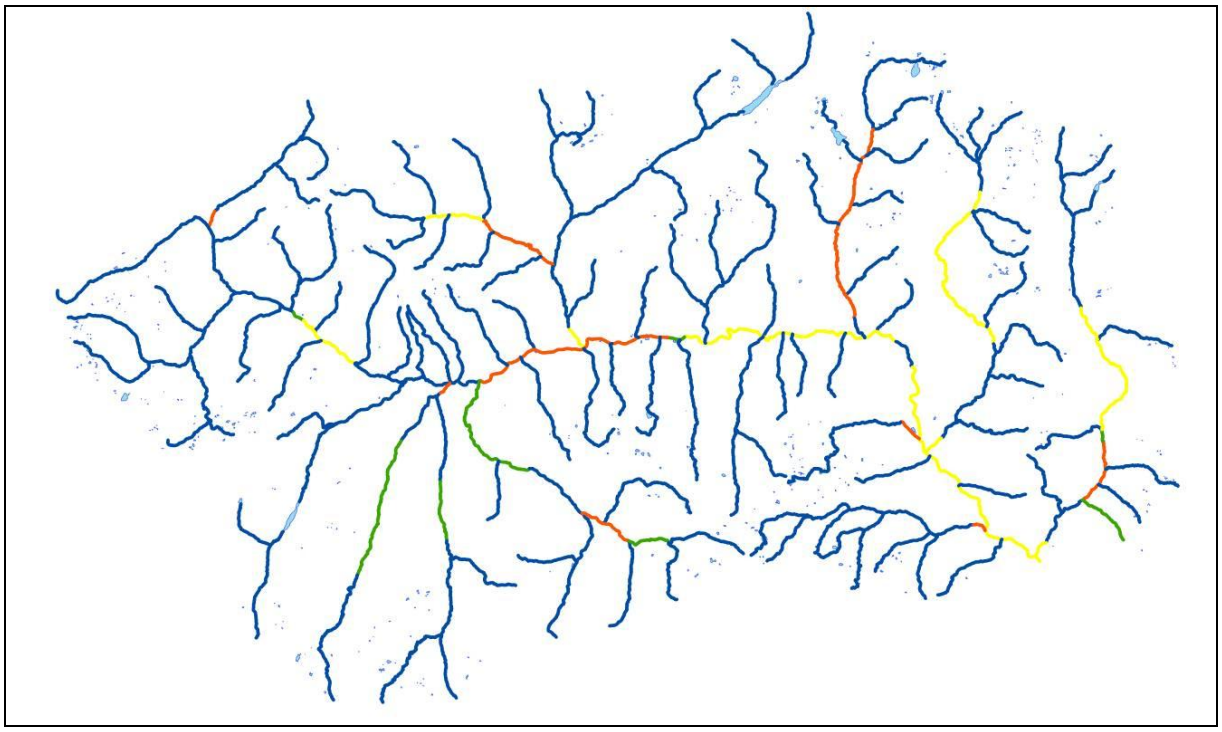
Weirs

In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] the weirs were classified according to the presence / absence within the watercourse, highlighting the presence of weirs systems in equidistant sequences [**Table 22** and **Image 28**].

Table 22 – Weirs classification [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

WEIRS	CODE	COLOUR
No weirs	0	
1 weir	1	
More than 1 weir	2	
Weirs system	3	

Image 28 – Weirs on the Dora Baltea river basin [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



Longitudinal alterations

In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] the longitudinal alterations were classified considering the percentage of watercourses affected by embankments and 5 classes were obtained [**Table 23**].

Table 23 – Longitudinal alterations classification [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

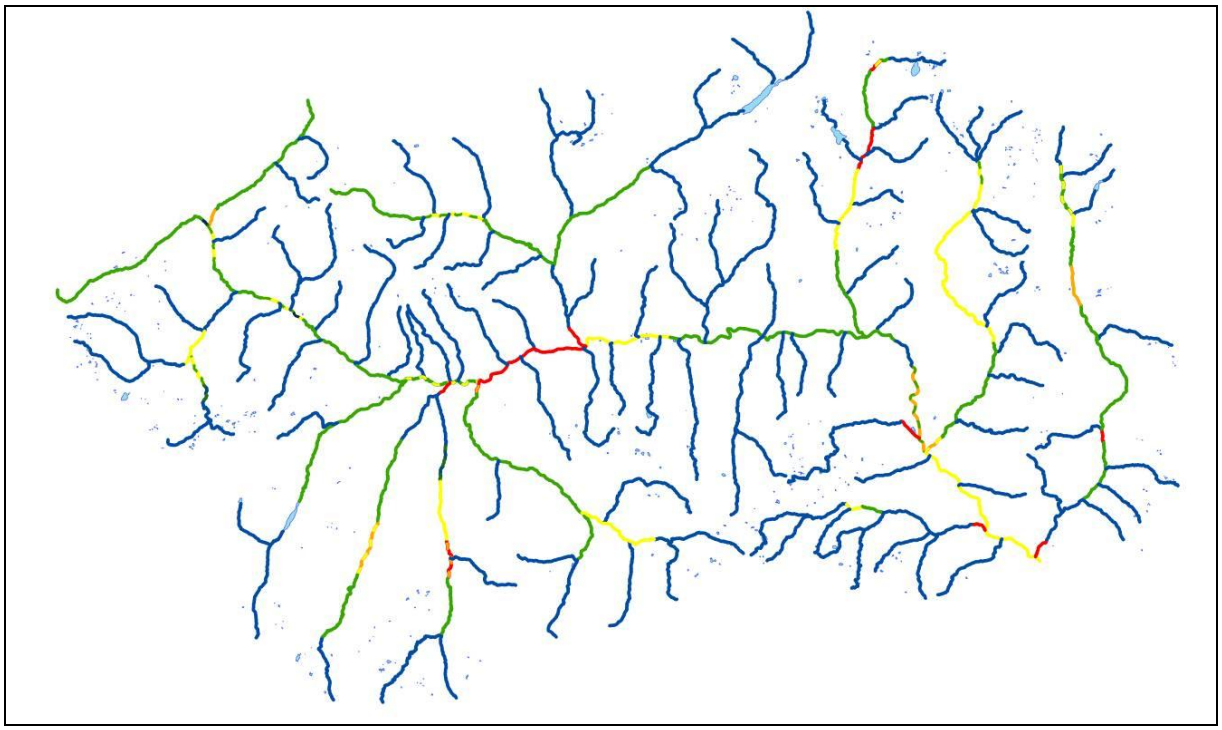
PERCENTAGE ALTERATIONS	CODE	COLOUR
No alterations	0	
1-25%	1	
25-50%	2	
50-75%	3	
75-100%	4	

In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] it was assigned a percentage value for each side of each watercourse, with the results shown below [**Table 24** and **Image 29**].

Table 24 – Longitudinal alterations classification [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

COLOUR	BANK 1 CODE	BANK 2 CODE
	0	0
	0	1
	0	2
	0	3
	0	4
	1	1
	1	2
	1	3
	1	4
	2	2
	2	3
	2	4
	3	3
	3	4
	4	4

Image 29 – Longitudinal alterations on the Dora Baltea river basin [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



5. Restoration and mitigation actions

The Aosta Valley region River Basin Management Plan defines three specific objectives to achieve for protection and restoration of all regional water bodies:

- Environmental quality and specific target objectives;
- Protection and restoration of river ecosystem objectives;
- Quantitative protection of water bodies objectives.

The Aosta Valley River Basin Management Plan defines for each objectives group, the actions to achieve the objectives of qualitative and quantitative protection of water resources and river eco system, as required by the Plan.

Actions and interventions to achieve the environmental quality and specific target objectives

To achieve the environmental quality and specific target objectives the Aosta Valley River Basin Management Plan identifies the actions and interventions following [**Table 25**]:

Table 25 – Actions and interventions to achieve the environmental quality and specific target objectives [extracted and modified from the Aosta Valley River Basin Management Plan. 2006].

ACTIONS	INTERVENTIONS
Indicators monitoring and cognitive surveys on water bodies	1. Management and maintenance of regional hydrological and environmental monitoring system 2. Activation and management of public information initiatives 3. Activation and management of Water Resources Information System
Collection and processing of civil and industrial discharges	1. Wastes discharges regulation and related construction permits 2. Organization of Integrated Water Service 3. Fulfillment of collection and processing of civil and industrial discharges system
Pollution control from farming and breeding	Management of pollution from farming and breeding
Definition of drinking water catching points protection areas	Definition of the perimeter of drinking water catching points protection areas

Actions and interventions for protection and restoration of river ecosystem

To achieve the protection and restoration of river ecosystem objectives the Aosta Valley River Basin Management Plan identifies the actions and interventions following [**Table 26**]:

Table 26 – Actions and interventions for protection and restoration of river ecosystem [extracted and modified from the Aosta Valley River Basin Management Plan. 2006].

ACTIONS	INTERVENTIONS
River bankfull protection	1. Discipline of actions on the bankfull 2. Catchments management projects
Landscape valorisation of watercourses	River redevelopment measures

Protection and valorisation of fish	Measures for protection and valorisation of fish

Actions and interventions for quantitative protection of water bodies

To achieve the quantitative protection of water bodies objectives the Aosta Valley River Basin Management Plan identifies the actions and interventions following [**Table 27**]:

Table 27 – Actions and interventions for quantitative protection of water bodies [extracted and modified from the Aosta Valley River Basin Management Plan. 2006].

ACTIONS	INTERVENTIONS
Water uses rationalization for farming, factory and drinking	1. Withdrawal authorizations discipline and withdrawal authorizations reassessment 2. Organization of Integrated Water Service 3. Rationalization of drinking water management and use 4. Rationalization of farming water management and use 5. Rationalization of factory water management and use
Protection and restoration of hydrological regimes	MIF definition

For further details consult the Aosta Valley River Basin Management Plan, 2006.