Chalamy basin

monograph

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Summary

SHORT DESCRIPTION
This document intends to provide a comprehensive description of the Chalamy 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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Introduction

This document intends to provide a comprehensive description of the Chalamy 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.

1. Pilot case study area

1.1 Basin characteristics

The Chalamy river basin has an area of 47 km^2 and an average altitude of 1880 m above sea level; the river comes from the slopes of Mont Glacier [2560 m] and flows as a tributary of the right in the Dora Baltea in the town of Issogne [365 m] [**Image 1**]. The Chalamy river through an area with high naturalness, in fact it's partially included in a protected area (Mont Avic Natural Park), but near to the confluence with the Dora Baltea river, it's evident an high increase of bed and banks artificialization.

Image 1 – The Chalamy river basin.

The Chalamy collects the contribution of many minor tributaries, including 7 from the left side, characterized by a quick development and high slopes, and 5 from the right side, with more development and lower slopes.
In the Chalamy Valley, there are more than 30 lakes, including the Gran Lago, the largest natural basin of the Aosta Valley located almost 2500 meters, and various peat bogs, characterised by an uncommonly interesting relict flora.
The landscape of the Chalamy valley is characterized by some extremely interesting aspects. Furthermore, the environment has only partly been affected by human activities. The rough orographic characteristics have, in fact, always been a hindrance to the traditional agricultural and stock-raising activities and, more recently, they have avoided the development of mass tourism, both in the summer and in the winter.
Over a third of the valley is covered in forests of mountain pines, scotch pines, larches and beeches. The forests and woods of the area, heavily depleted in the past to meet the needs of the mining activity, have partly recovered their original features and are exceptionally beautiful.
The Chalamy valley is also marked by other interesting natural aspects, such as the Alpine floristic endemism and the plant communities linked to the substratum of green rocks. No other area in Aosta Valley has such a large number of lakes, marshes and peat bogs. The fauna includes all the most typical Alpine animals living in the region [**Image 2**].

Image 2 – Some image of the Chalamy river basin [extracted from the Mont Avic Natural Park website].

The flora of the area is deeply affected by the presence of a large number of wetlands and ophiolite outcrops, i.e. rocks that make the soil poor and shallow.
The valley is characterized by unusual plants, at least a regional level. Among them, there is the largest mountain pine forest of Aosta Valley. This conifer, not very widespread on the Italian Alps, grows well in soils impoverished by the serpentinite and can also survive near peat bogs. Another interesting element is represented by the geographical position of the Chalamy Valley, located close to the substantially dry area of the Central Aosta Valley and partly affected by the more humid climate of the Lower Valley.
This contrast becomes more evident, when you go from the north-facing to the sunny sector, where the beech is gradually replaced by the scotch pine, which best copes with the dry climate.

1.2 Geolithological and land cover characterization

From the geological viewpoint, the Chalamy Valley is part of the Piedmontese Complex of Calcschists with green rocks. The complex, here mostly consisting of the ophiolite from the ultrabasic Complex of Mont Avic, represents a fragment of the Piedmontese oceanic basin, involved in the Alpine orogeny, as a result of the continental collision between Africa and Europe.
The serpentinites (hydrous magnesium silicate) are rocks that can be found almost everywhere in the Chalamy area and, therefore, characterize its landscape and biological aspects, but there are also rocks of a different kind, basically mica-schist, gneiss, metamorphic gabbro and amphibolite with garnet-bearing chlorite-schists.

Image 3 – Some image of the Chalamy river basin geomorphology [extracted from the Mont Avic Natural Park website].

The calcschists, corresponding to the sediments that originally settled on the oceanic basin, are not very common inside the valley. The presence of mineralization of magnetite and iron-copper in the rocks of the Chalamy Valley has been well known for centuries and has given rise to mining activities. A noteworthy characteristic concerns the many minerals discovered in different areas of the Park, in veins of rodingite (apatite, epidote, garnet, smaragdite, vesuvianite and so forth).
The morphology of the Chalamy Valley is characterized by high peaks and deep valleys [**Image 3**]. The schistosity direction of the metamorphic rocks is relatively regular, with a dip to the north and causes a clear asymmetry of the two main sides. Along the orographic left, the slopes are rather steep, while the right side has a milder morphology with rises, level ground and depressions (the latter is partly the result of the swarms of faults).
The action of the Quaternary glaciers (erosion, ablation and deposit) is especially evident in the southern sector of the valley, which is rich in smooth, striated rocks, “roches moutonnées”, as well as many glacial cirques currently occupied by lakes. In the eastern side, there are important moraine deposits and several erratic boulders.
The watercourses have deeply carved the valley and transported the solid materials down towards its outlet. Other deposits characterizing the Mont Avic landscape are the debris cones and talus, covering large areas at the foot of the rocky slopes, as well as the filling deposits of ancient lacustrine basins, with the consequent formation of peat bogs.

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 that includes the Chalamy river basin, there are the land cover typologies shown below [**Table 1**].

Table 1 – 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

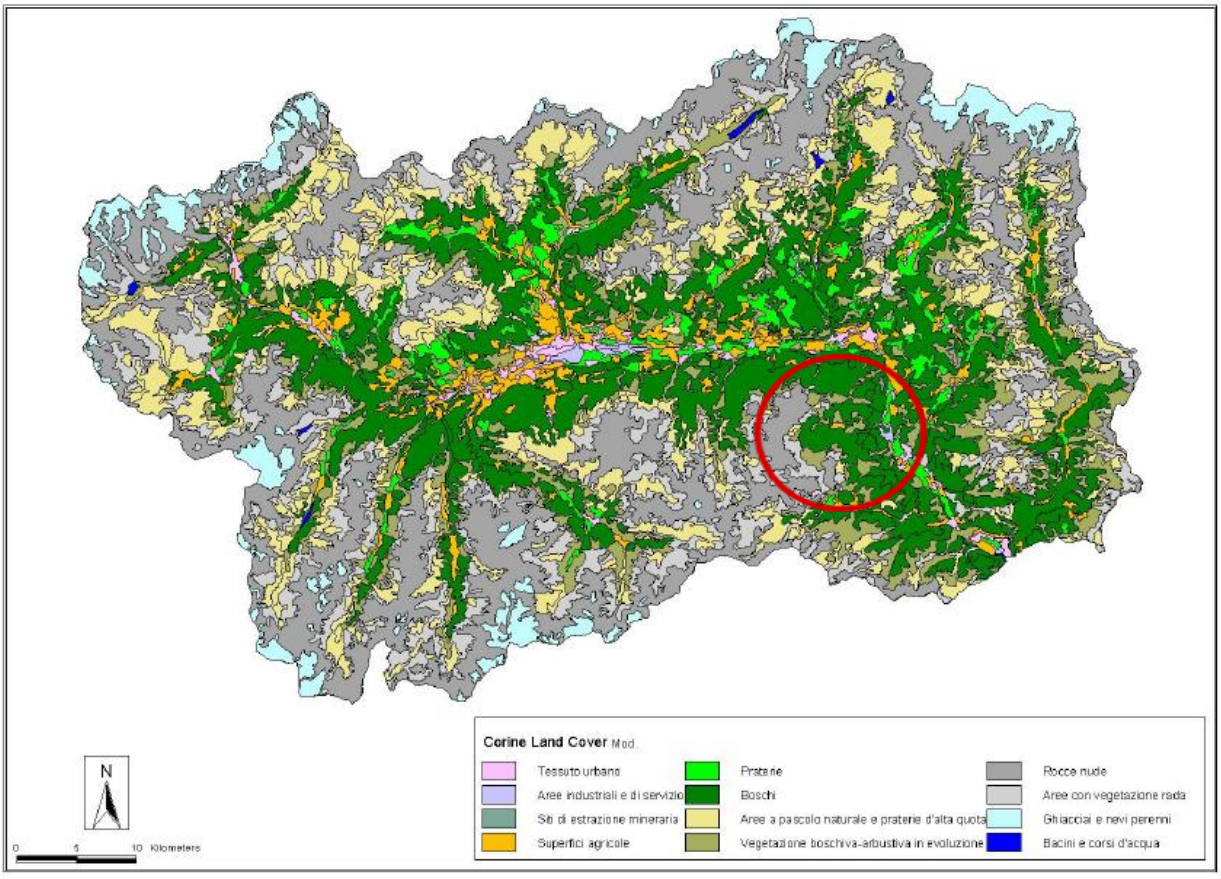
The development map produced for the Aosta Valley River Basin Management Plan has simplified the map CORINE Land Cover aggregating certain types, such as continuous and discontinuous urban fabric which have been reunited in one type [urban fabric]. From the reworking of the surfaces were obtained the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

Table 2 – 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 4**].

Image 4 - 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 Chalamy river basin has a wide superficial hydrographic network and several lakes [**Image 5**], even some large ones, for example Gran Lac, the largest natural basin in Aosta Valley. Considering the lack of sizeable glaciers (the only small glacier is located on the north side of Mont Glacier), the water supply of the main watercourses in the summer is ensured by the late thaw, on the high slopes facing north and by the water of the colluvial and glacial deposits.

Image 5 – Some image of the Chalamy river basin lakes [extracted from the Mont Avic Natural Park website].

The hydrological regime, characterized by substantial differences in the flow rate, mainly due to the mainly superficial soils, reaches the minimum level in the winter and the maximum level in the late springtime.
The considerable and widespread circulation of underground water explains the presence of numerous springs. The resurgences located on the low orographic left side, give rise to particular environmental contrasts, since they are located in basically xeric environments.

1.4 River quality

1.4.1 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 Chalamy river basin are not currently sufficient for a characterization for the WFD. By the end of 2010 will be available for regional hydrographic network of Aosta Valley, the first information about some biological components such as macroinvertebrates, diatoms and phytobenthos. The data relevant to testing the Chalamy 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.

1.4.2 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 Chalamy river basin is a Dora Baltea river sub-basin and it is totally included into the "1 – Inner Alps" HydroEcoRegion [**Image 6**].
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. [quoted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

1.4.3 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 Chalamy river, was classified in two river typology [**Image 7** and **Table 3**]. In general, for the Dora Baltea river basin that includes also the Chalamy river basin, 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. SS= surface flow] 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]. [quoted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

Image 6 – HydroEcoRegions present in the North-West of Italy [quoted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].

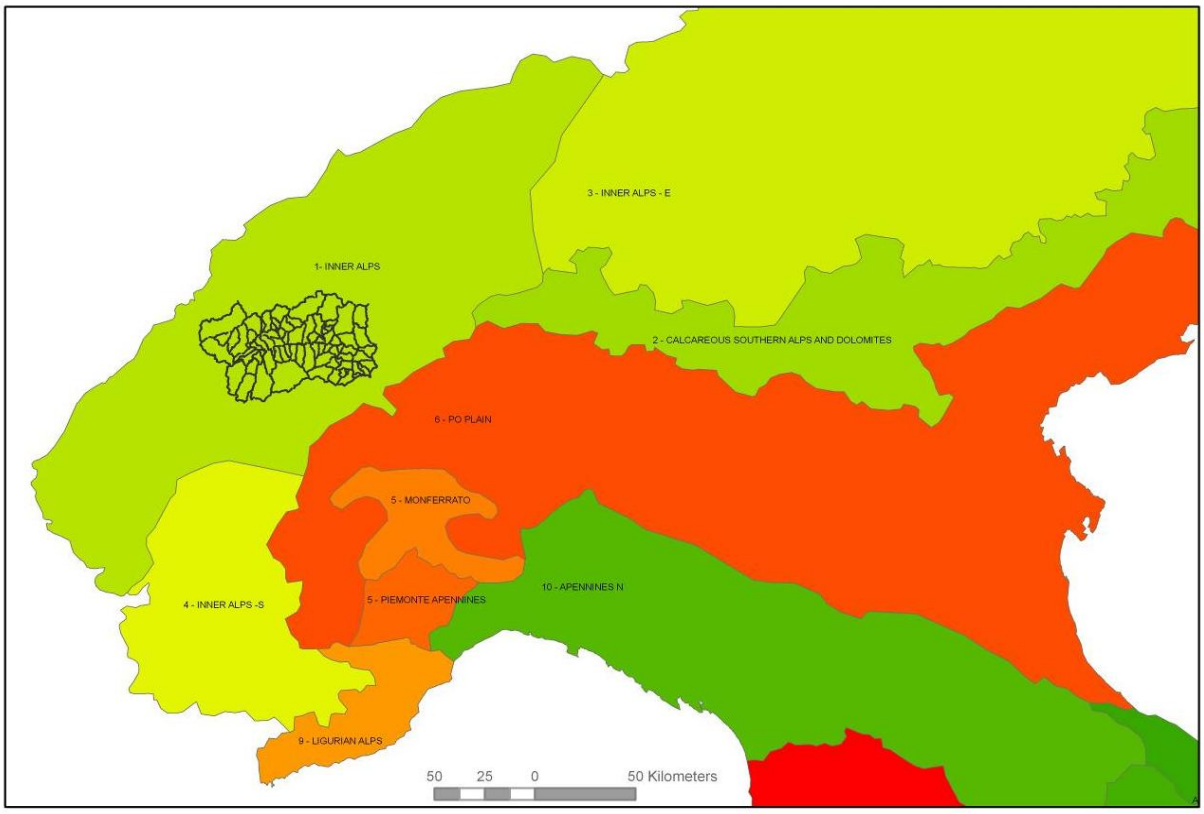
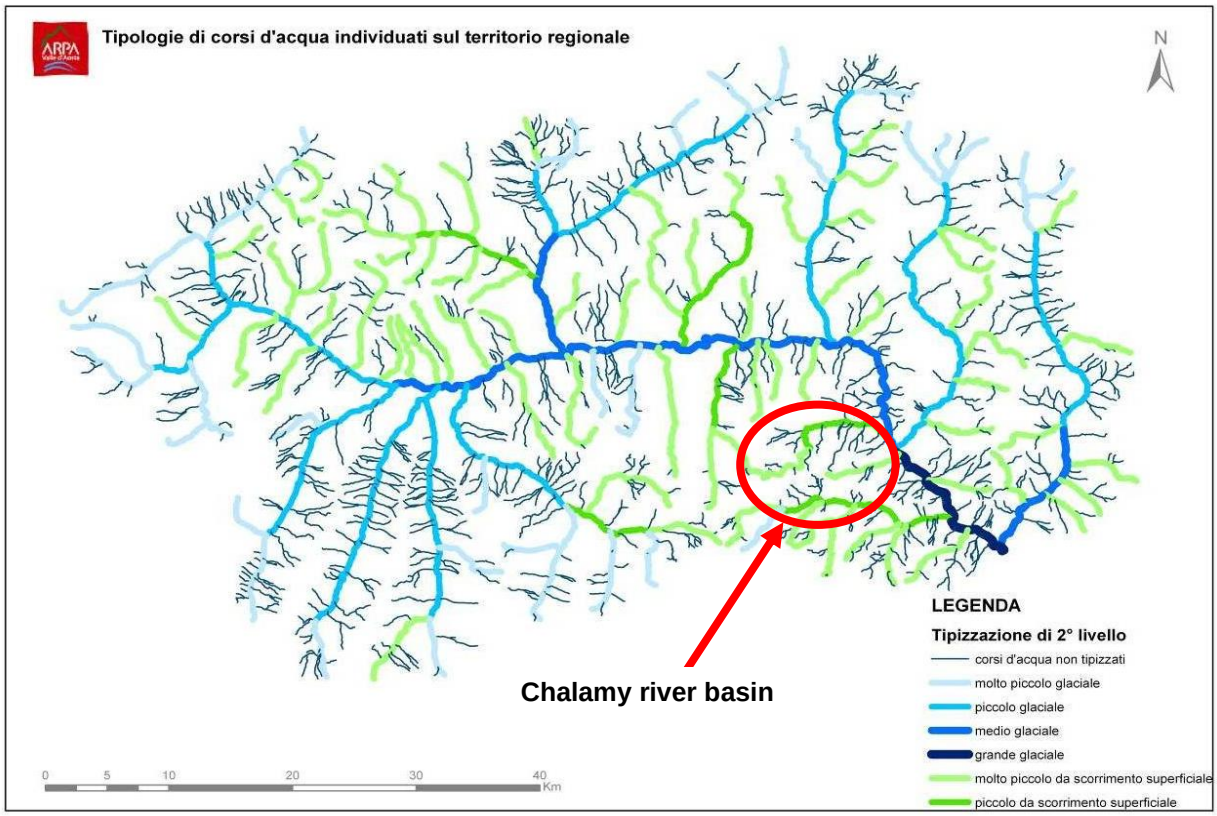


Table 3 - The Chalamy river typologies.

RIVER	TYPOLOGY	LENGTH [KM]	TYPOLOGY DESCRIPTION
Chalamy	01SS1N	6,77	very small surface flow
Chalamy	01SS2N	10,05	small surface flow

Image 7 – Dora Baltea river typology [quoted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].



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

The Chalamy river basin is partially included in the Mont Avic Natural Park the first natural park of Aosta Valley, that was set up in October 1989, with the idea of preserving the natural resources of the upper-central Valley of the Chalamy torrent (commune of Champdepraz).
The high basin of Chalamy river have been declared "Site of Community Interest" (SCI), included in "Natura 2000", the ecological network of the European Union, which intends to ensure the conservation of the habitats and species listed in the EU directives 79/409 and 92/43. The environments included in the site are the hardwood and coniferous forests, the peat bogs and the ophiolitic sites at high altitude.

- **The hardwood and coniferous forests**: The forests dominate the landscape of the Mont Avic Natural Park, covering almost the whole area until over 2000 m altitude. The Chalamy Valley is absolutely unique in the region, because of the largest mountain pine forest of the Italian Alps and thanks to its larch woods, that can be found nowhere else in the whole of the Central-Upper Aosta Valley. The protection of the Mont Avic forests is ensured by making the hikers follow the beaten tracks and by applying restrictions to cutting. The cultivation activities aiming to improve the "seed forest" and some minor uses of the timber in the more productive and less vulnerable sectors are the only activities currently authorized.
- **The peat bogs**: The peat bogs, that can rarely be found in the western Alpine valleys, are, conversely, quite numerous in the Mont Avic Natural Park and can be considered as the most important biotopes of the protected area. In fact, they include a large number of animal and plant species, usually either rare or totally absent in Aosta Valley. This is due to different micro-environmental conditions. In fact, in an area between 1270 m and 2550 m altitude, where the orographic conditions are extremely variable, we can see all the various stages typical of the filling process of the lacustrine basins, a process leading to the formation of peat bogs. The flora of the peat bogs includes many types of moss (even 13 different types of sphagnum), rare species, such as *Carex limosa, Carex pauciflora, Trichophorum alpinum and the peculiar Drosera rotundifolia*, a small insectivorous plant localized to Aosta Valley. Peat bogs are extremely vulnerable environments. Their protection entails the maintenance of the natural superficial hydrological regime. There must be no alteration of the vegetation cover caused

by people or domestic stock. Therefore, the Park Authority has fenced some of the most precious wetland areas, for protection reasons.

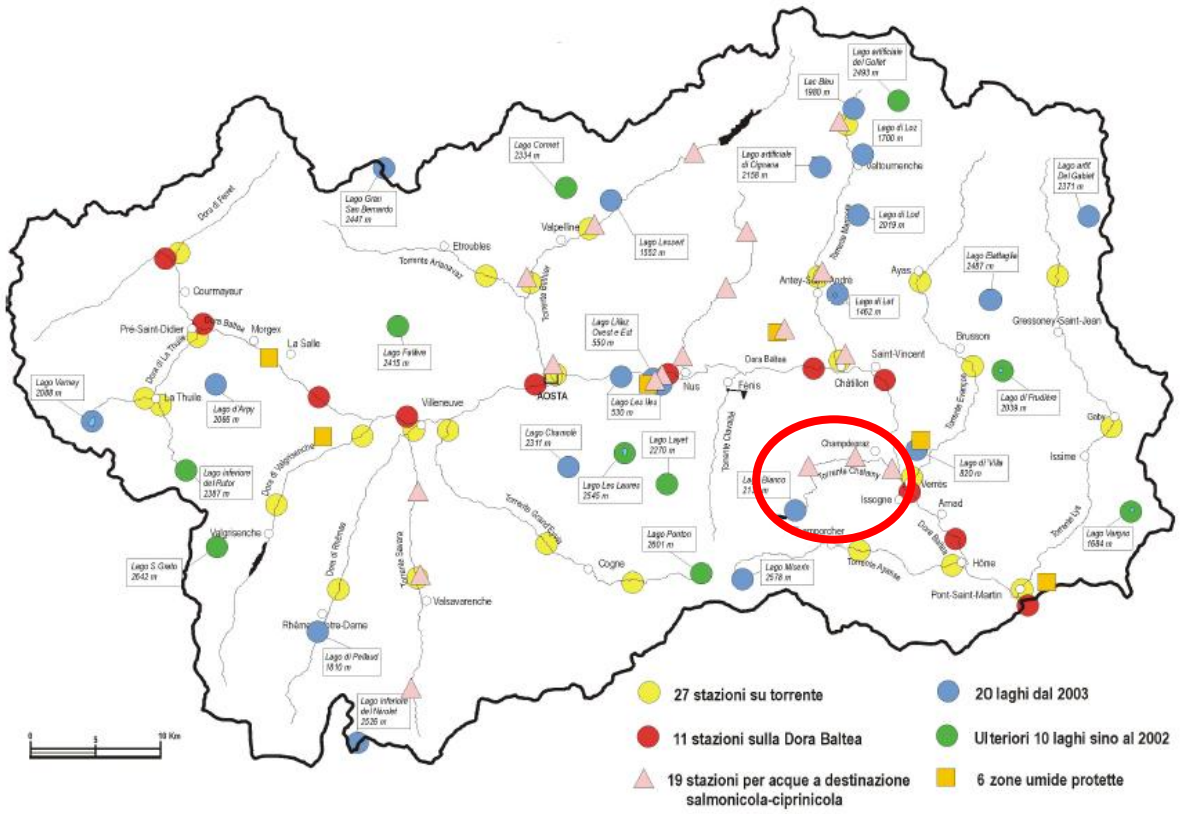
- **The ophiolitic areas at high altitude**: These sites are marked by large quantities of green rocks (mainly serpentinite and metamorphosed gabbro and peridotite) that make rather poor and superficial soils, rich in heavy metals, that have a toxic effect on most plants. The vegetation cover is, therefore, reduced and offers limited feeding opportunities to the animals. Nonetheless, the fauna is characterized by a surprising variety of species. The flora of the serpentinites is quite peculiar and dominated by the herbaceous plants that tolerate the presence of toxic microelements, for example crucifers like *Thlaspi* and *Cardamine*. The various species of lichens covering the rocks indicate a high degree of naturalness of the area and the complete absence of pollutants. The high frequency of parasite lichens that grow on other lichens is possibly due to the environmental conditions generated by the climate and the special characteristics of the green rocks. In order to ensure an effective protection of the ophiolitic areas, hikers are asked to follow the official beaten tracks, so as to keep the disturbance to wildlife to a minimum and avoid damaging the vegetation cover as well.

2.2 Monitoring programs

The monitoring network of the Chalamy river basin is managed by ARPA Valle d'Aosta and until 2008 was composed of [**Image 8**]:

- 1 monitoring station on the lake [lago Bianco];
- 3 monitoring stations for “salmonicol and cyprinicol” waters.

Image 8 – 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 9**].

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 10**]. 13 of these monitoring stations are identified as the reference type sites for the WFD typologies and called "network core". One of these 13 monitoring station had been placed on the Chalamy river.

Image 9 – 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].

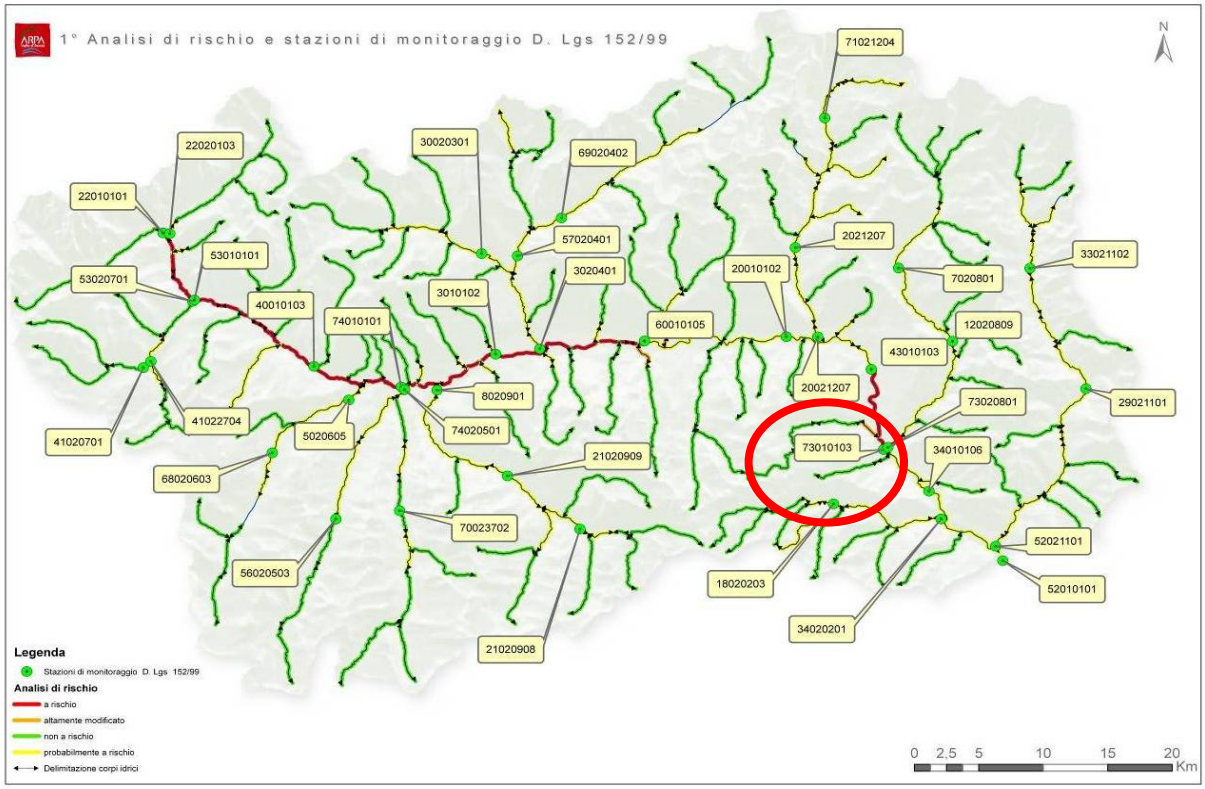
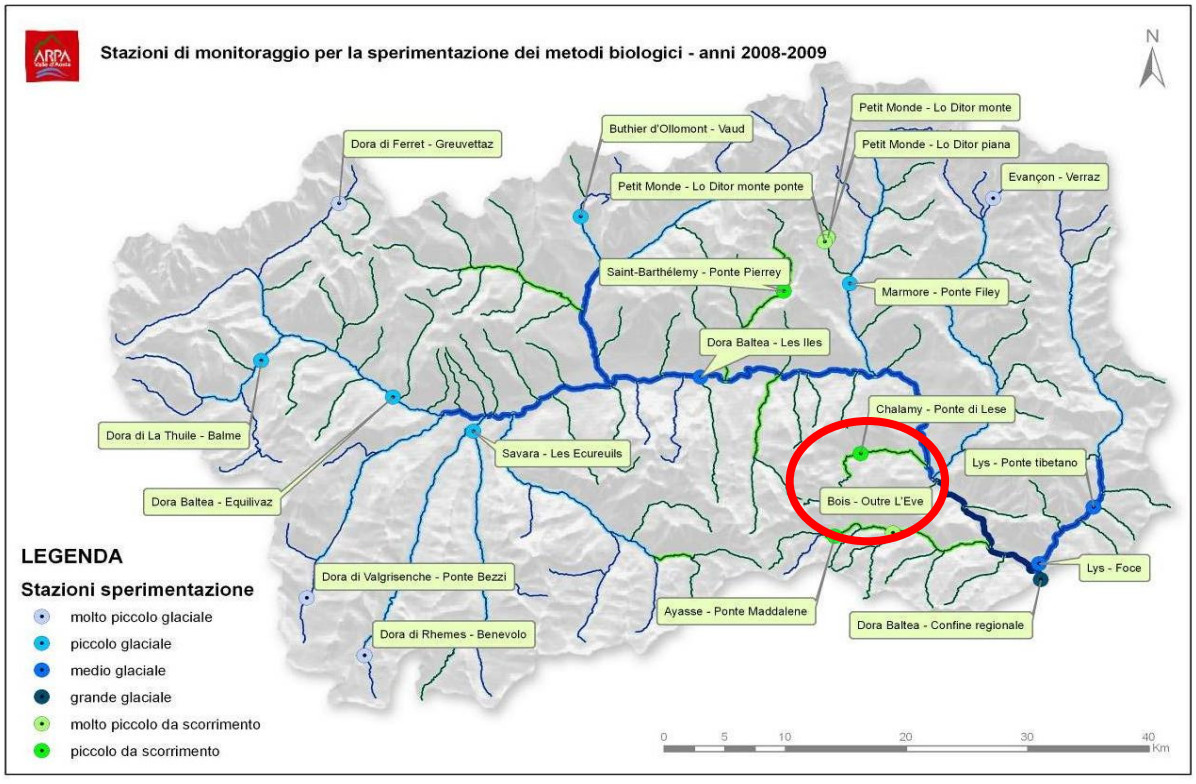


Image 10 – Map of monitoring network of Dora Baltea river basin for testing new investigation methods [extracted from the document: *"Tipizzazione dei corpi idrici superficiali"* – ARPA – Aosta Valley region. Draft, 2010].



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.**

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. On the Chalamy river ARPA had identified in total 202 monitoring stations [**Image 11**] distributed as follows:

- **3 Surveillance monitoring sites**: in which 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)
- **1 stations monitored exclusively under the D.lgs. mentioned above**.

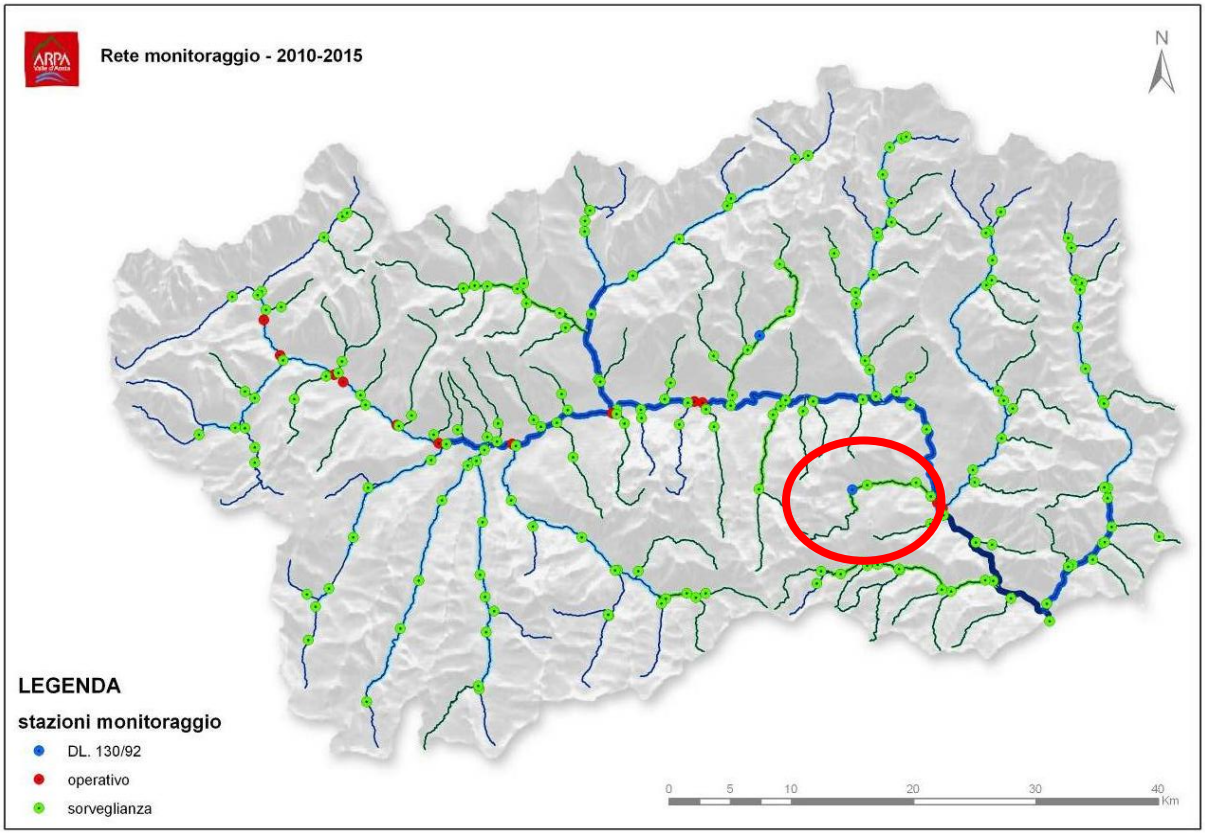
As required by the WFD in all monitoring stations are performed monitoring of biological components [**Table 4**]:

- 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 1 monitoring station included in the "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.

Table 4 - Monitoring network of Chalamy 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
Macrobenthos	X	X
Diatoms	X	X
Macrophytes		X
Physic-chemical paramenters*	X	X
FREQUENCY	[three-monthly*] six-monthly	[three-monthly*] six-monthly

Image 11 – Final monitoring network for 2010 [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

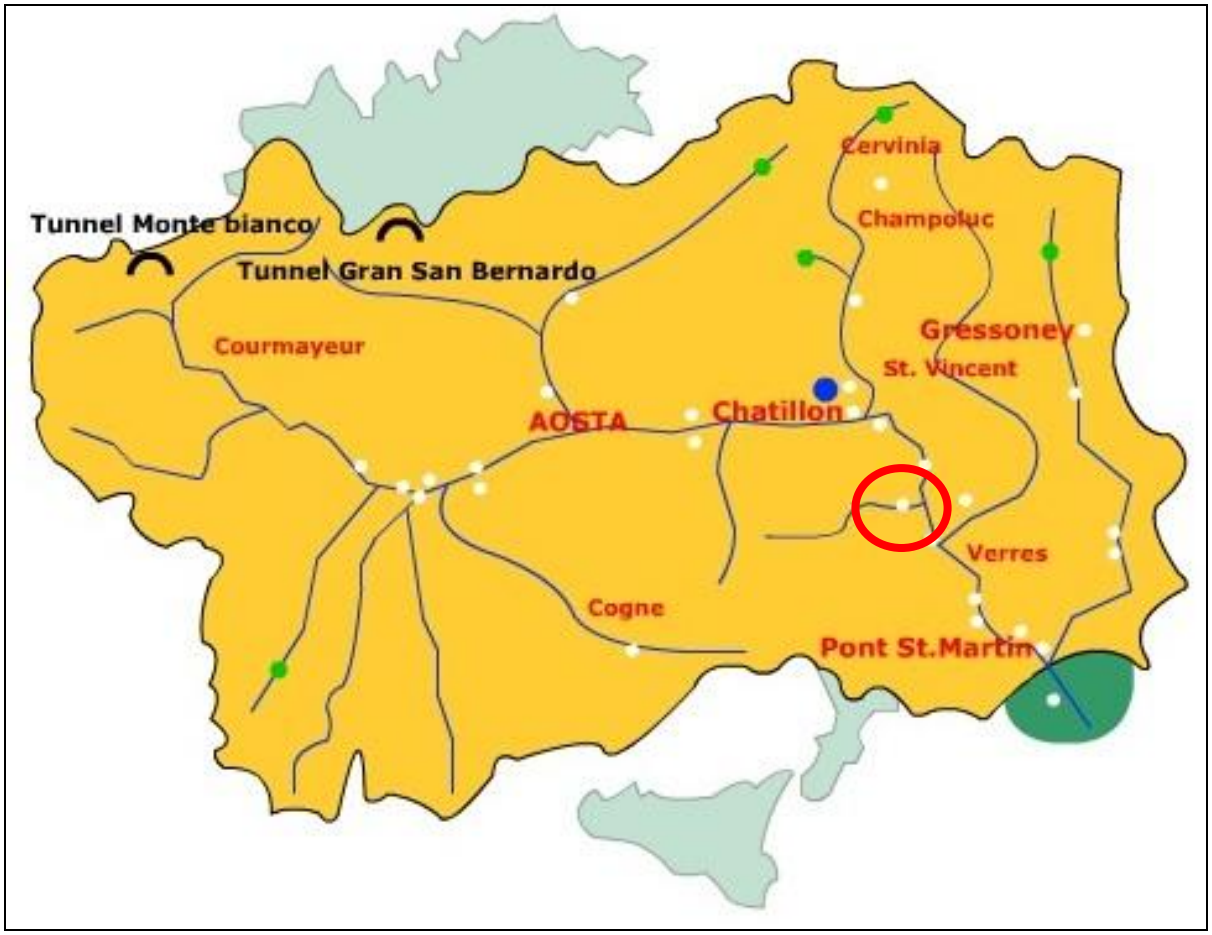


3. Water uses

3.1 Hydropower exploitation

In the Chalamy river basin there are 4 HP plants different for typology and power installed [data source Aosta Valley Region - data uploaded to 2009]. Of these 1 is of Aosta Valley Water Company [CVA] property [**Image 12**] and 3 are private.

Image 12 – Aosta Valley Water Company HP plants [extracted from Aosta Valley Water Company website].



The gross power of the installed plants on the Chalamy basin is 3,324 MW: 2,908 MW for CVA plant and 0,416 MW for private investment [data source: RAVA – 2009].

Annual energy production at river basin scale

To be done

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

In the Chalamy river basin the MCA will be applied to 1 existing CVA plant located along the Chalamy river with the aim to detect the MIF quantity to release from the withdrawal considered.
The HP plant considered along the Dora Baltea river is shown below. For the HP plant is available a short description including number, location and power installed, and a essentially photographic documentation.

CHEVRERES INTAKE			IMAGE
Code	CVA-A-CHE		
Property	CVA		
Plant	Champdepraz		
Typology	run-off		
Other intakes	yes		
Power installed	2,3	MW	
Energy yearly production average	15	GWh	
Year building	1919		

3.2 Waste discharges

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

3.3 Touristic fruition

The touristic fruition typologies on the Chalamy river basin are numerous:

Naturalistic fruition

The landscape of the Chalamy river basin, partially included in a protected area, the Mont Avic Natural Park, is characterized by some extremely interesting aspects. Furthermore, the environment has only partly been affected by human activities. So the Chalamy river basin offers numerous opportunities of naturalistic fruition that attract many visitors and fans every years:

- **the ophiolitic areas at high altitude**: these sites are marked by large quantities of green rocks (mainly serpentinite and metamorphosed gabbro and peridotite) that make rather poor and superficial soils, rich in heavy metals. The flora of the serpentinites is quite peculiar and dominated by the herbaceous plants that tolerate the presence of toxic microelements, for example crucifers like *Thlaspi* and *Cardamine*. The various species of lichens covering the rocks indicate a high degree of naturalness of the area and the complete absence of pollutants.
- **geomorphologic interest sites** such as gorges and ravines, high peaks and deep valleys;
- **damp zones with a interesting flora**, typical of wetlands characterized by boreal plants, which, on the Alps, are either rare or endangered. Among the rarest and most localized species, characteristic of the peat bogs there are *Carex limosa, Carex pauciflora, Eriophorum vaginatum, Trichophorum alpinum* and the insectivorous plant *Drosera rotundifolia*;
- **the hardwood and coniferous forests**: the forests of mountain pines, scotch pines, larches and beeches dominate the landscape of the Park, covering almost the whole area until over 2000 m altitude. The Chalamy Valley is absolutely unique in the region, because of the largest mountain pine forest of the Italian Alps;
- **more than 30 lakes** including Gran Lac, the largest natural basin in Aosta Valley

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]
Along the Chalamy torrent, between Lac Blanc and the Perrot bridge, located south of Chevrère, there is a private trout-fishing area. They only allow fly fishing and apply the following rules: fly-line with not more than three flies, barbless hooks, release of the fish in water without landing net and without dragging the fish ashore. A limited number of anglers can daily access the fishing area. The anglers must have the relevant state license and the annual permit or the daily permit released by the fishing-area manager The fishing area is open from Monday to Friday, holidays excluded and in compliance with the regional schedule for special days and events.
People holding the state license and the relevant annual, monthly, weekly or daily regional permit are also allowed to fish on the other parts of the Chalamy torrent, as well as on the other streams and lakes of the Park, provided that they comply with the rules of the fishing schedule.

Water Sport

In the Chalamy river basin there is a water sports that every year attract hundreds of tourists and fans: the canyoning. Canyoning involves sliding down deep gorges and jumping into mountain rivers among waterfalls, natural sloping surfaces and limpid pools. The final part of the Chalamy torrent is perfect for this sport, thanks to its many small waterfalls, smooth rocky sides and deep pools. In the summer, the "No Limits Center Valle d'Aosta" organizes canyon trips with competent local guides. The most interesting path along which can be applied canyoning is represented in the next image [**Image 13** and **Image 14**].

Image 13 – Map of water sport distribution on the Dora Baltea river Basin [extracted from the Aosta Valley River Basin Management Plan. 2006].

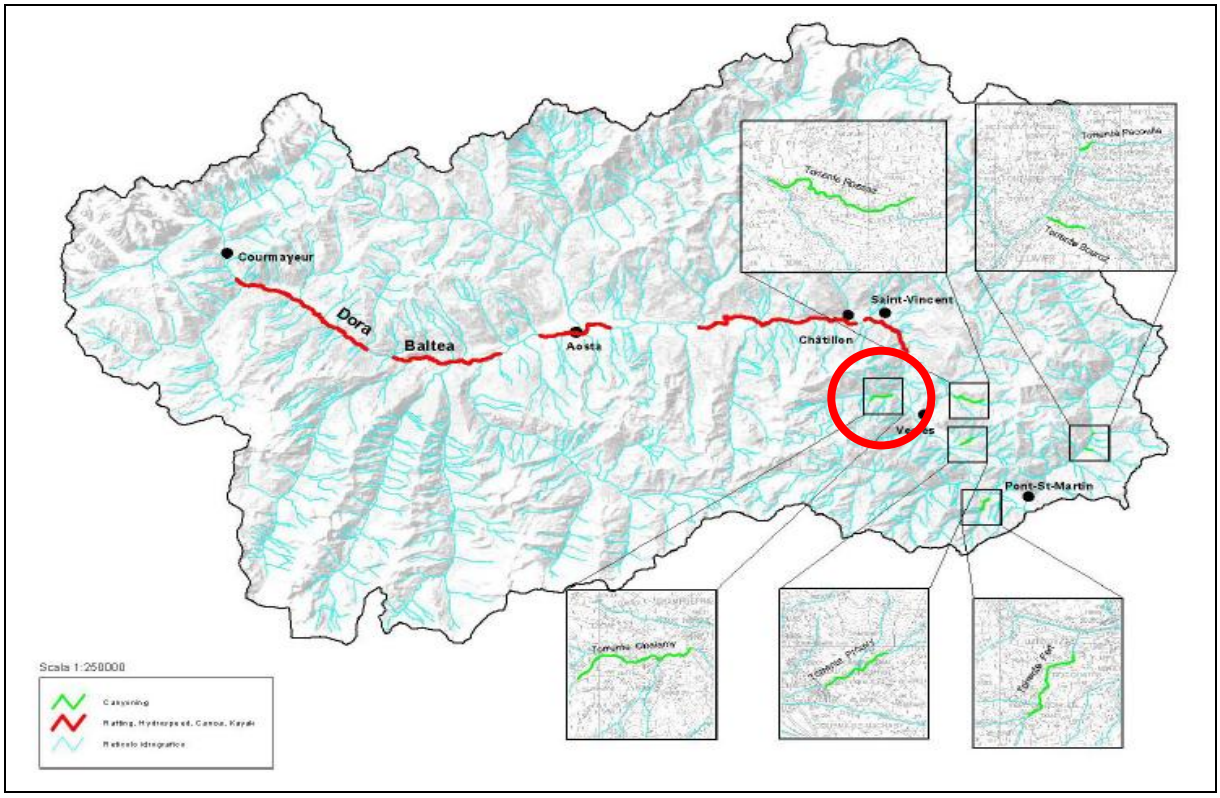


Image 14 – Images of water sport on the Chalamy river basin [extracted from the Aosta Valley River Basin Management Plan. 2006].

4. Pressures and impacts related to water uses

4.1 Land use

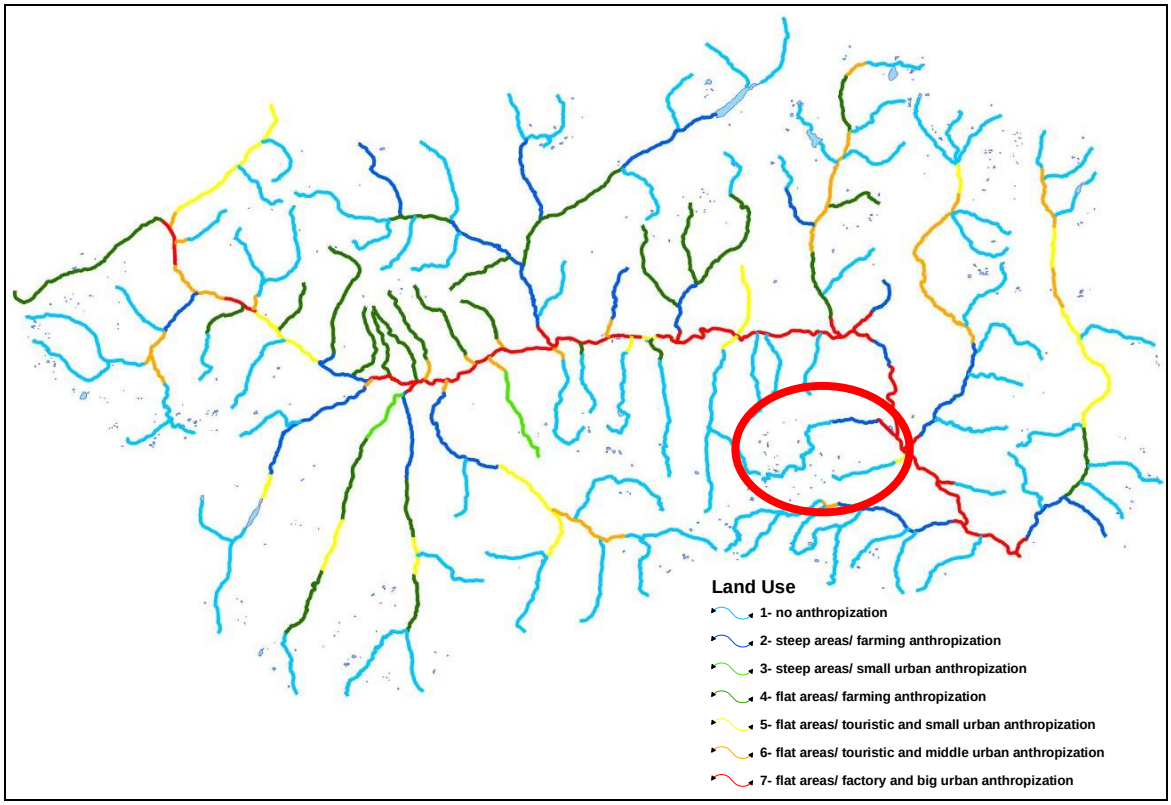
The land use is intended as the land anthropization. In document "*Tipizzazione dei corpi idrici superficiali*" - ARPA - Aosta Valley Region [Draft, 2010], has been created a spread pressure classification based on a scale divided into seven classes. The land use categories are ordered from 1 to 7 in order of increasing anthropization [**Table 5**].

Table 5 – 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 15**].

Image 15 – Final monitoring network for 2010 [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



4.2 Waste discharges

Cesspools

In the Chalamy river basin are present 4 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 6**, **Table 7** and **Image 16**].

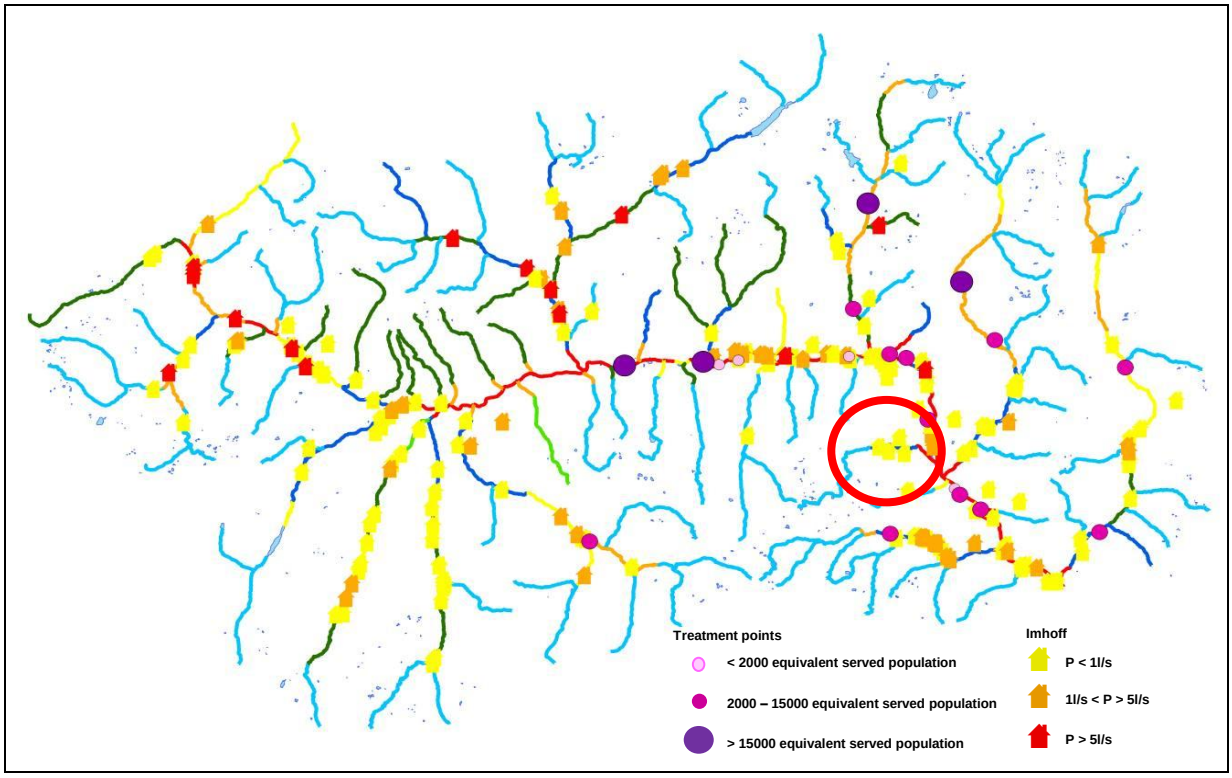
Table 6 – Imhoff typology [extracted and modified from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].

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

Table 7 – Cesspools on the Chalamy river basin [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	Champdepraz	Gettaz Boden river	0,300	< 1
Mayor	Champdepraz	Pelode river	0,300	< 1
Mayor	Champdepraz	Barbustel river	0	< 1
Mayor	Champdepraz	Lavaz	0,100	< 1

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

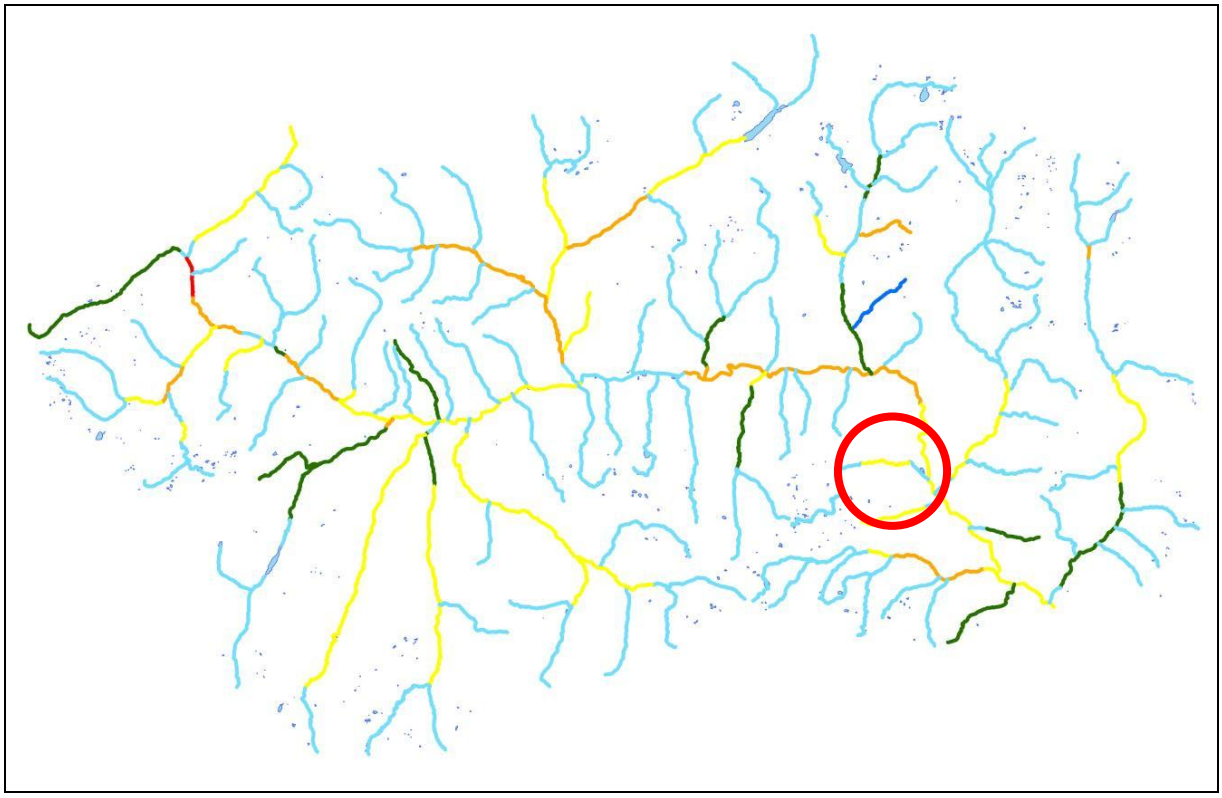


In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010] to better assess the overall impact the Imhoff density was determined by calculating for each watercourse the Imhoff flow summation divided by the length of single watercourse in km, obtaining a value expressed in l / s / km. The density values obtained were grouped into seven classes in order of increasing pressure [**Table 8** and **Image 17**].

Table 8 – 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

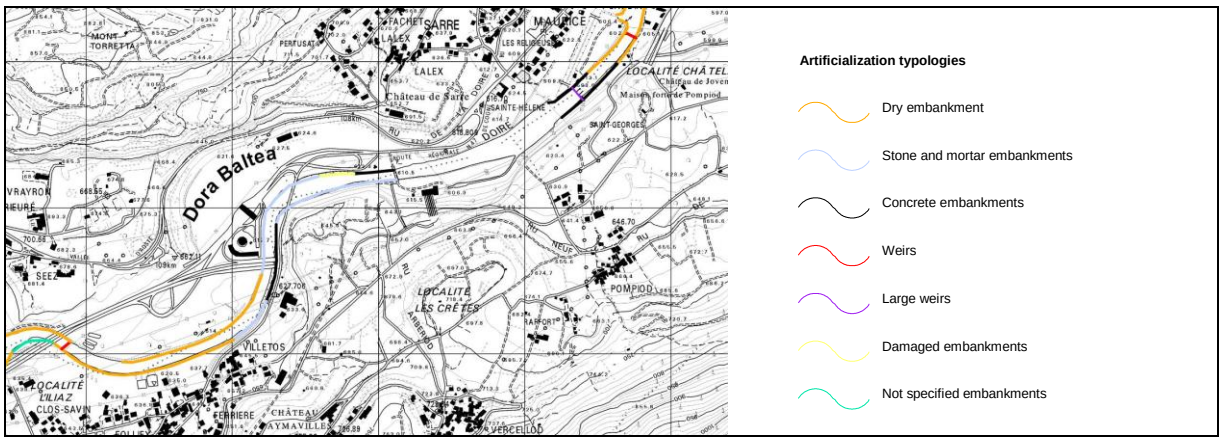
Image 17 – Imhoff pressure on the Dora Baltea river basin [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



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 18**].

Image 18 – 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].



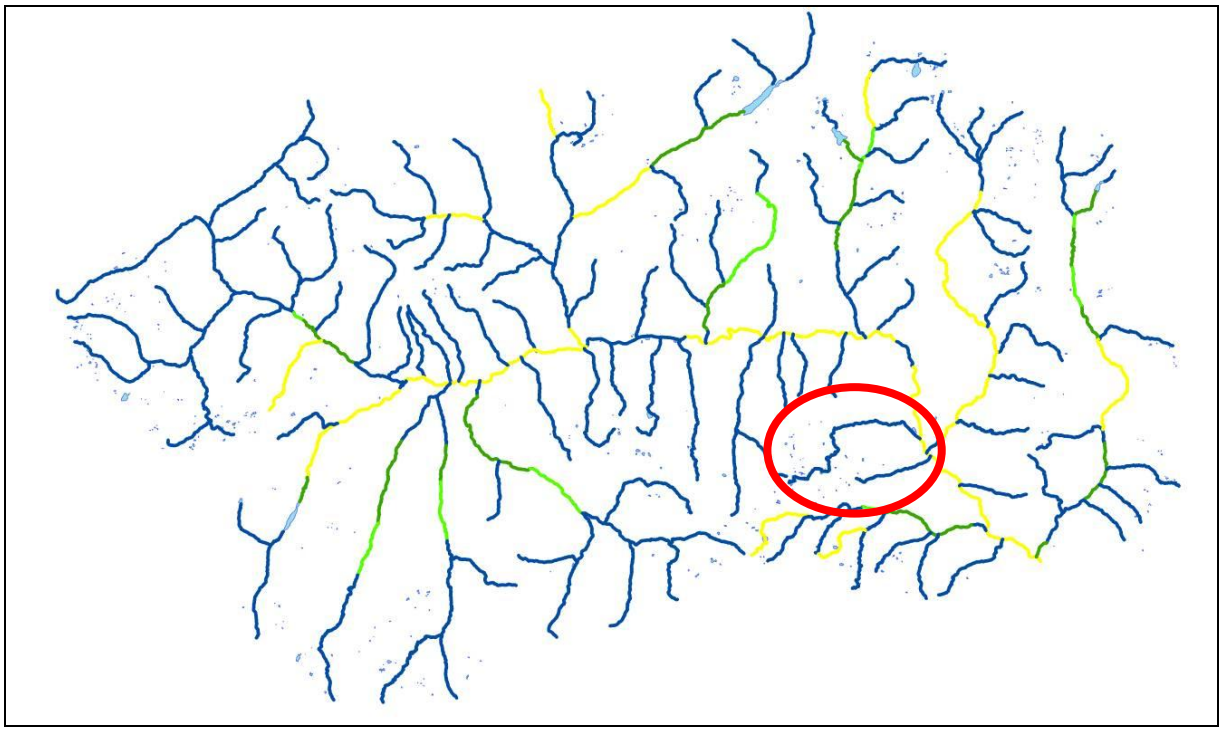
In the document "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley Region [Draft, 2010], were evaluated separately:

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

Dams and large weirs

There are not dams and large weirs in the Chalamy river basin [**Image 19**]

Image 19 – Presence of major barriers on the Dora Baltea river basin [extracted from the document: "*Tipizzazione dei corpi idrici superficiali*" – ARPA – Aosta Valley region. Draft, 2010].



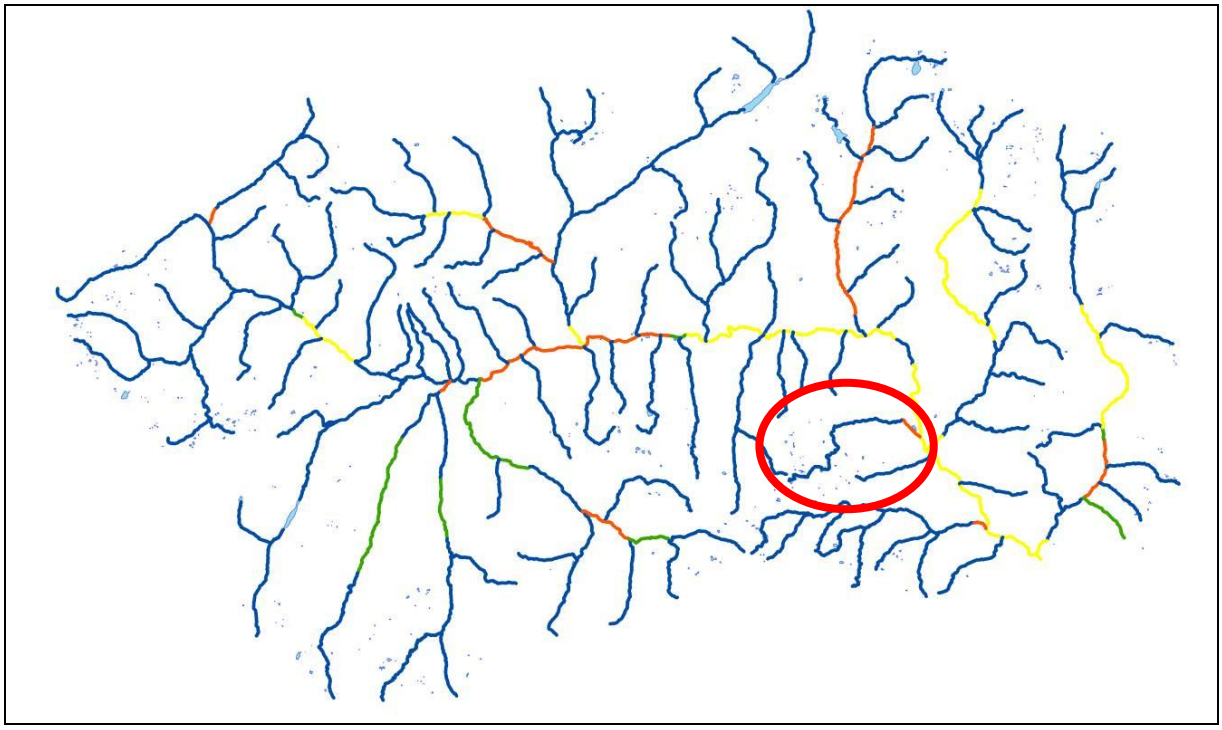
Weirs

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 9** and **Image 20**].

Table 9 – 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 20 – Weirs on the Chalamy 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 10**].

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

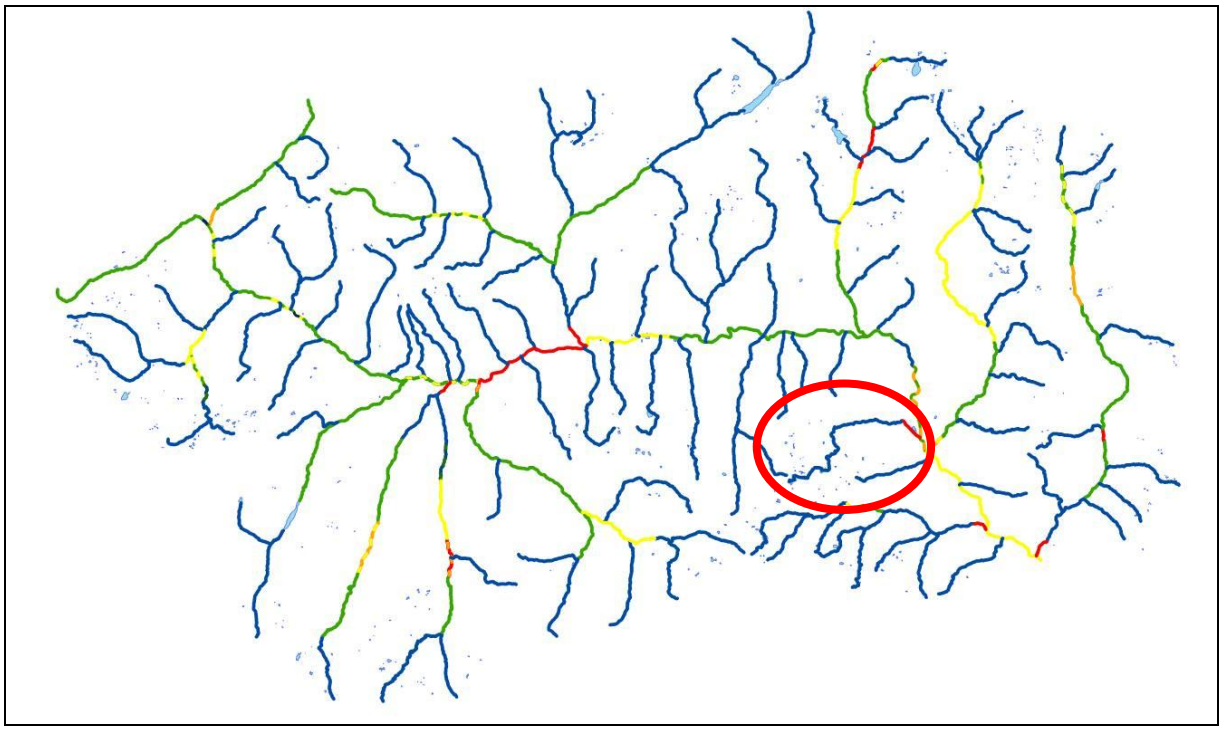
PERCENTAGE ALTERATIONS	CODE	COLOUR
No alterations	0	
1-25%	1	
25-50%	2	
50-75%	3	
75-100%	4	

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 11** and **Image 21**].

Table 11 – 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 21 – 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 12**]:

Table 12 – 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 13**]:

Table 13 – 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 14**]:

Table 14 – 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.