Action 7.2-B

Var monography

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Summary

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

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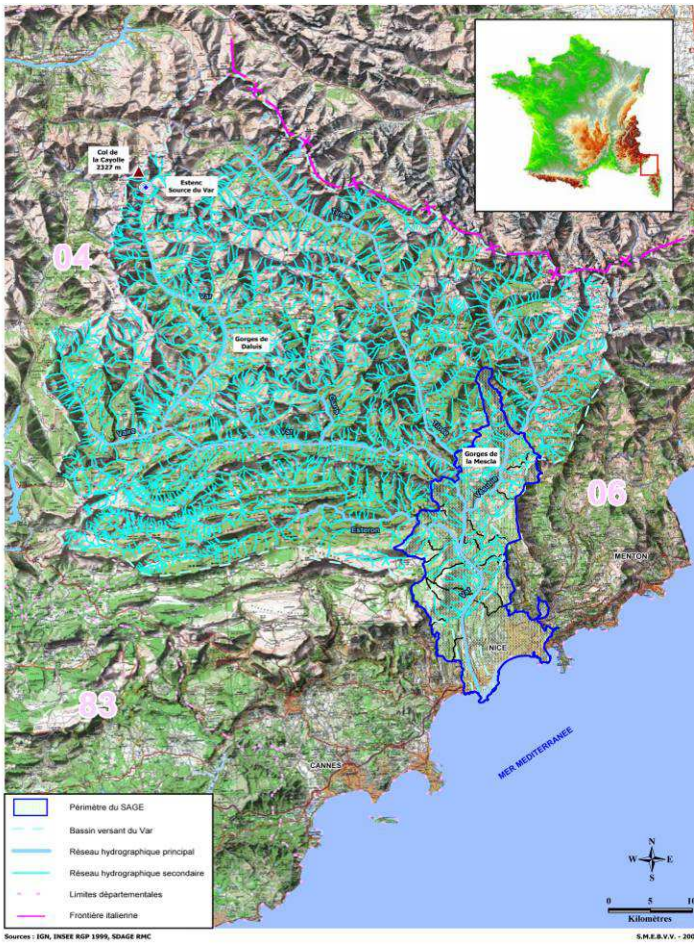
1. Pilot case study area

1.1 Basin characteristics

River basin considered (Basse Vallée du *Var*)

The river basin considered is the Lower *Var* Valley, or in french : “Basse vallée du Var”, BVV. Its area is about 346.5 km². This river basin is located in the French “Alpes-Maritimes” department.

Geographical situation of the river basin considered



Source: SAGE Nappe et basse vallée du Var – Atlas cartographique, 2006

Tributaries

The main tributaries of the *Var* join it upstream to the low valley and are not concerned by the perimeter of the Lower *Var* Valley. These tributaries are *Tinée*, *Esteron* and *Vésubie*.

The runoff water and the rain water infiltration in the pudding stones ("dark valleys") are taken into account in the tributaries flow. The network density is extremely important; the whole hairy reaches 130 km.

Orientation

The river basin of he *Lower Var Valley* is North ➔ South.

The SAGE program

The "SAGE Nappe et Basse Vallée du *Var*" is a maintenance program for the river *Var* in its lower part. This program exists since 2007.

This document identifies the *Var* valley as an "outstanding area but very damaged aquatic space". The aim of the program recommendations is to bring back the natural functioning of the river.

The SAGE's scope

Source: SAGE Nappe et basse vallée du Var – Atlas cartographique, 2006

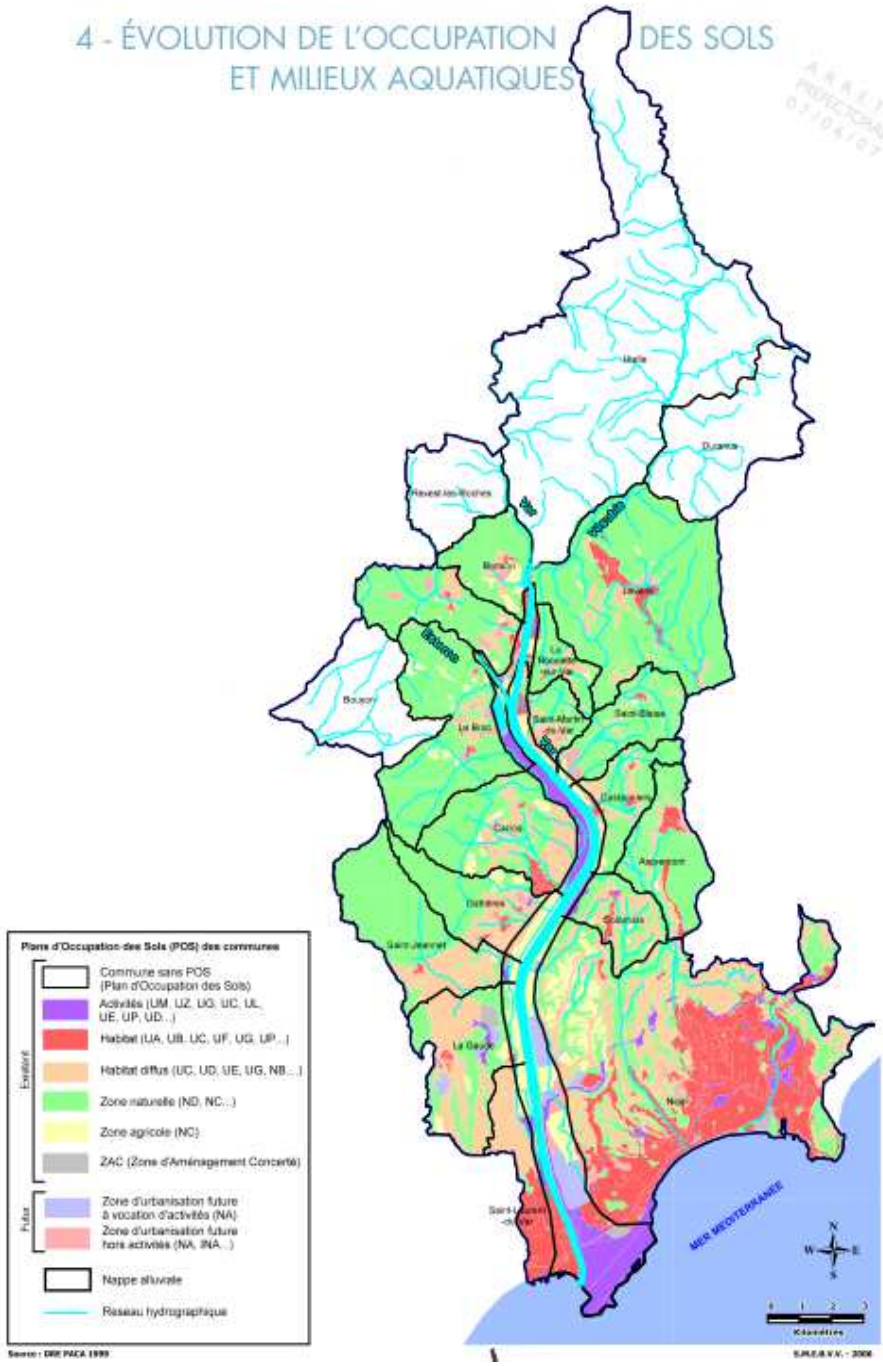
1.2 Geolithological and land cover characterization

Description of landscape

We distinguish 4 areas in the broad outlines:

- The “Gorges of Mescla”, upstream: majority forest cover on abrupt slopes, limited human activity;
- The “Côteaux”, modelled in terraces: traditional cultures of vineyard and olive tree remain, the forest gains ground, few urbanization;
- The “low valley of the *Var* river”, divided in perpendicular strips in the bed: tree nurseries, truck farmings and orchards are in competition with the industrial or commercial business parks;
- The littoral fringe is completely urbanised.

Land use and aquatic environments



Source: SAGE Nappe et basse vallée du Var – Atlas cartographique, 2006

Gorges of the *Mescla* and the parade of Chaudan:

The road and the railway occupy the narrow bottom of the valley, they are partially implanted on the ancient bed of the *Var*. In the gorges, walls are high and vertical. The rare vegetation on the heights is rupicolous and with a Mediterranean type, giving an aspect of ground stripped (covered forester 52 %, stripped grounds 41 % of surfaces)

In this mineral environment, the human activities are few, except some terraces of culture on the alluvial edges. Following the arrangements of the bed of the *Var*, were implanted narrow kitchen gardens between the stream and the road. Villages are perched on rock peaks, benefiting from the maximum of period of sunshine.

The low valley of the Var, the côteaux, the littoral range:

With the management of the *Var*, rich lands gained ground on the alluvial plain. Divided in perpendicular strips in the bed, some of them benefits of fine particles, blocked during the overflowing of the river (tree nurseries, horticulture, orchards 23 %). Henceforth, industrial or commercial business parks compete with the agricultural uses and contribute to the waterproofing of important surfaces of the valley (14 %). On hillsides modelled in terraces the forest recovers 50 % of the surface, reaching culture traditional of vineyard and olive trees. The urbanization spreads modify the landscape. The littoral fringe is very built by economic, industrial centers, detached and collective housing.

Geology

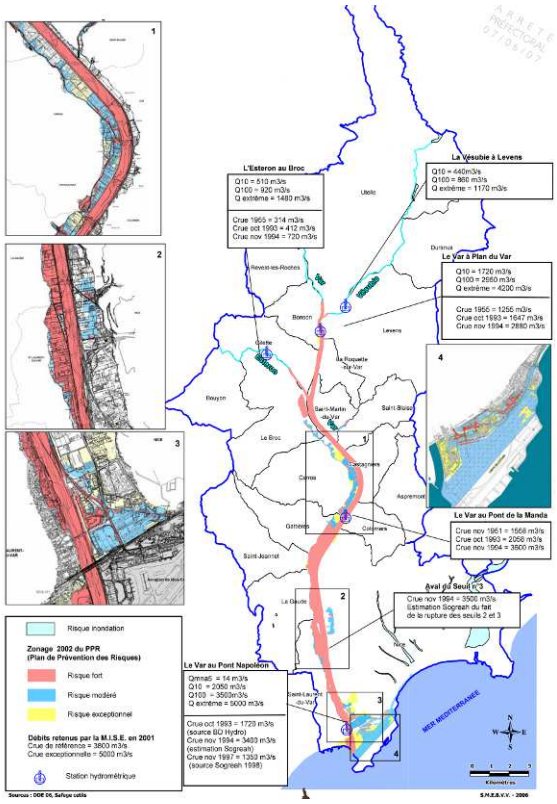
On the scale of the *Var* low valley, the quaternary alluviums of the *Var* river *form the* base of the pliocene pudding stones of the delta of the *Var* river. On this base, there is a layer of marls more or less mixed with breaches based on Jurassic limestones.

1.3 Hydrological characterization

Flow data

The *Var* flow is characterized in the considered basin by quantified data only from two stations of registration: in “Plan du Var” and Nice (airport)

Flow data and flood risks



Source: SAGE Nappe et basse vallée du Var – Atlas cartographique, 2006

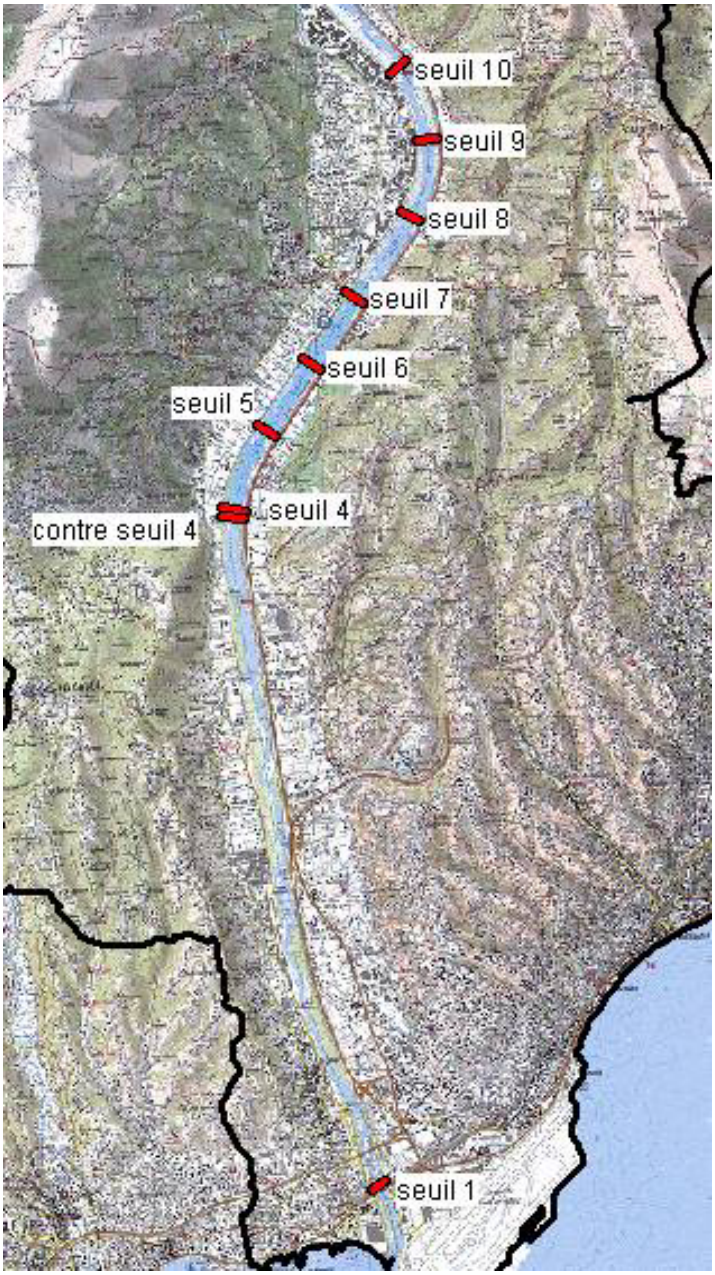
Meteorology: rain distribution

The precipitations spread out mainly from October until May and accumulate 747 mm a year.

Hydro-geomorphology / erosion (history)

- Before 1950: The progressive confinement of the *Var bed* had for consequence to decrease the area offered for the materials deposit and thus to accelerate a slight increase of funds by deposit of gravels, in particular in downstream area.
- In the 50s, the material extraction (gravels) appeared to be a remedy for this increase. But the overexploitation of gravel pits (the extractions had begin to be more important than the natural contributions of the *Var* river) entails little by little the fall of the bed: the water table decreased. These phenomena had been observed from 1960.
- 1970: To eradicate these negative impacts on the bed river and the water table, some sills were built from 1970. The sills crests had been established at the level of the *Var* river in 1912, redrawing the water line of the Var.

Sills location



Source: SAGE Nappe et basse vallée du Var – Atlas cartographique, 2006

Then, because of the sills, the solid transport had been disturbed: storage upstream from the sills, and erosion downstream. The bed slope was globally lower than before, with many falls (by 5 meters) caused by the sills. On the other hand, the extractions soil continued without a real control, entailing the trapping of all the materials (unrefined in the upstream and the silt in soil them).
The deposit of silt upstream the sills had stimulated the tree structure vegetation to grow. This phenomenon increased appreciably the levels of floods. As a result the local capacity of the minor bed is lower than the 100-year floodplain, this is particularly striking in the low part of the valley.

- In the middle of the 80s, micro-power plants were settled in the third of the width of sills, accompanied with an access road. Besides the rise of the levels in flood, the heterogeneousness flow caused erosion of the bottom of the sills.

➔ So, in the *Var* river which should have an intense solid transport connected to a strong flow and a strong slope, gravels no more moved forward by carriage downstream of the sill 10.

➔ The whole low valley of the *Var* river presents an overdrawn sedimentary system. The residual solid flow is considered by 35 000 m^3/year on average. It is very variable according to hydrology and rainfall.

➔ These sediments, the transport of which is slowed down towards the downstream by the presence of sills, accumulate upstream to sills and cause several effects:

- During the floods, the reservoirs are filled with sand and stones. It causes an increase of the bed of the river and consequently of the water level. The flow is slowed until 60 % and the flood risk is aggravated.
- The sealing of the bed of the river by slow silt slowed the exchanges between the river and the water table.
- The water take for the water supply of the city of Nice, upstream from the sill 8^{th}, is going to be also filled and discontinued if no measure of cleaning is taken.
- The sills engravement bring to a reduction in productivity of the power plants.

2. Plans and management programs

2.1 Existing management plans and application rules

- *SAGE Basse vallée du Var 2007, issu du SDAGE Rhône Méditerranée Corse de 1996*
- *Directive territoriale d'Aménagement, appliquée pour le département des Alpes Maritimes 2002* - Approved in 2003, this document shows the problems due to space competitivity between different activities, and the disappearing of natural landscape each year. In Lower Var valley, flood risk is important and urbanization has to be contained.
- *Charte pour l'environnement de la Ville de Nice (2001)*

2.2 Monitoring programs

Monitoring programs about hydrologic factors

The *Var* river in its low valley, zone of study, is not measured in regular stations. The hydrological data concern the whole river, even streams of the department and do not reflect the dynamics of the zone of study.

Monitoring programs about river quality[1]

Bentic invertebrates

The global hydrobiological study of the *Var* is not homogeneous; the statements are punctual and draw up a qualitative state of the environment only for the 1st and 3rd sills. However, the IBGN (Normalized Global biological Indication) is decreasing in the upstream towards the downstream. Habitats become less diversified and the polluo-sensitive species are disappearing gradually.

Generally speaking, the construction of sills created a typological sliding: the rheophiles species (who like running water) declined when the limnophiles (who like stagnant or weakly running water) increase. So, the natural species of alpine Mediterranean torrents were gradually changed by species of plain.

The eutrophication trend in this terminal part of the stream can be considered as normal.

Piscicole fauna

Before the enactment of sills, the diadromous species (being able to live in salt-and-fresh water) swimming upstream or downstream the *Var* river along two or three kilometres : Mullet, Bass, Smelt. The amphibiotic fishes as the shad feint or the silvery trout (alternating their development between fresh water and salt water), were swimming upstream easily to reproduce. The blennie (or castagnette) typical of the parts swallow Rhone and coastal courses of waters, frequented all the low valley.

Some of these fish species are now protected and registered in annex III in Berne Convention. The Barbeau Meridional is protected and registered in annexe II and V in Directive “habitat”, and in annexe III in Berne Convention.

Hydropower plants are the major cause of damage for these fishes, because of the hydraulic infrastructures. Master passes with fishes with which are equipped sills today are for the greater part ineffective and these species live downstream the sill 4. Except some eels, the fish migrations are extremely rare.

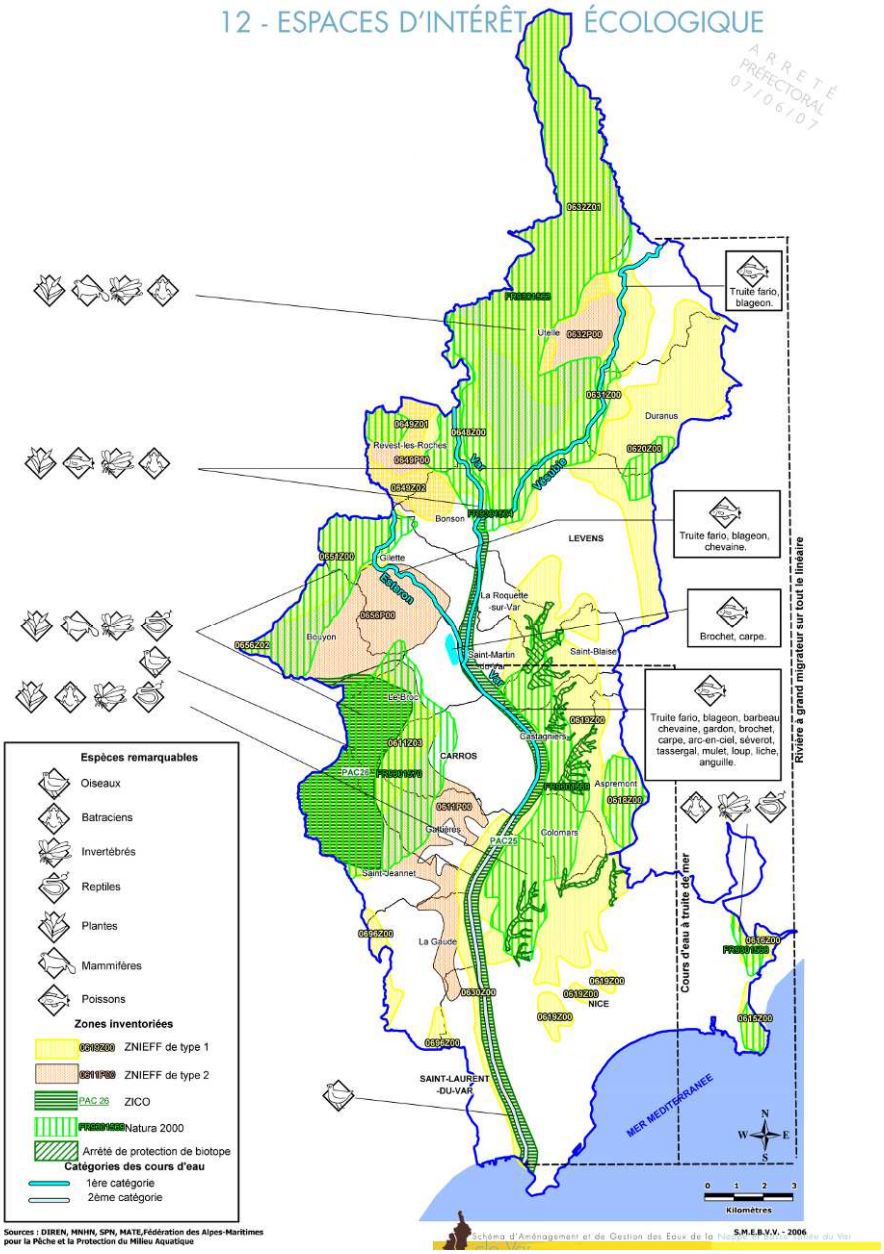
Monitoring programs about terrestrial environment of the river

- *Zone Natura 2000*
- *ZNIEFF 628 ha de type 1 0630ZOO (de l'embouchure au pont de la Manda) 1988. ripisylve artificielle due aux seuils et pour la faune terrestre et avicole (nidification et migration)*

[1] SAFEGE schema d'aménagement et gestion de l'eau “nappe et basse vallée du var” 2002

- *ZICO, 1991*

Monitoring programs about terrestrial environment



Source: SAGE Nappe et basse vallée du Var – Atlas cartographique, 2006

3. Water uses

3.1 Hydropower exploitation

Annual energy production at river basin scale

The annually hydropower produced throughout the *Var* river basin amounted to 60 GWh [data source: RWE 2011].

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

N° SILL	NAME	LOCALITY	PLANT	>POWER >HEIGHT, >DERIVATED FLOW >INSTREAM FLOW	ACTIONS PLANNED IN THE SAGE PROGRAM
8	Selve	Castagniers	In service	>2515 KW >4,93 m. >52 m^3/s >3 m^3/s	To be lowered
7	La Manda	Colomars	In service	>2030 KW >3,98 m. >52 m^3/s >3 m^3/s	To be lowered
6	Les Cappans	Nice	In service	>2367 KW >4,64 m. >52 m^3/s >3 m^3/s	To be lowered
5	La courbe	Nice	In service	>2377 KW >4,66 m. >52 m^3/s >3 m^3/s	To be lowered
4	St Sauveur	Nice	In service	>2469 KW >4,84 m. >52 m^3/s >3 m^3/s	To be lowered

The annual production of every power plant is on average between 8 and 9 GWh

3.2 Farming

The water taken in the river is not practically used in agricultural purposes, but in purposes of the drinkable water supply. Gardens and orchards of the lower valley of the *Var* are irrigated from pumping systems in the water table (2/3) and from upstream tributaries of the *Var* river (*Vésubie* river in particular).

3.3 Factory

The water taken by the industrial purposes arises in 50 % of the water table, 50 % of channels. Half of these takings is dedicated to the airport of Nice.

3.5 Drinking water

The drinking water taken in the zone of the Low valley of the *Var* arises from harnessing in the aquifer. The harnessing systems pump in the aquifer and are not concerned by the evolutions of sills. Only a taking at the surface upstream from the 8th sill could be unusable if the intake of water is filled with sand and stones; that should be the case if the power plant is destructed.

The quantities of water taken in the aquifer increased from 27 million of m^3 to 43 million of m^3 in thirty years from 1980 to 2010 (approximately + 40 %).[2]

3.6 Touristic fruition

Fishing

The fishermen are not authorized to walk on the small islands of the river, so fishing is non-existent in the zone of study, between sills 16 and 1. It is practised in the mouth and on the upstream of the *Var* river.

Water Sport

Bathing and navigation are strictly forbidden in the *Var* low valley. The Natura 2000 area forbids any entertaining use of the bed of the river. Nobody can practice kayak or kite-surf upstream because of sills.

Ornithology

The low valley of the *Var* river is the seat of numerous ornithological fauna species, both by its abundance and by its diversity. On 295 species indicated in the district, 233 were counted in the lower course of the river Var. Because of its avifauna quality, the plain of *Var* is recognized as an Important zone for the Preservation of Birds : CAP(COMMON AGRICULTURAL POLICY) 25. The whole public domain of the low valley of the *Var* constitutes a protected area which name is" bird sanctuary of the low valley of the *Var* " (1986).

[2] Safege opus cité

4. Restoration and mitigation actions

The objectives of the SAGE are to lower sills to enable the flow of sediments, lower the water line of the *Var* river, in order to return to a natural wide spaces and so minimize the risk of floods. Maintenance of opened zone (without vegetation) allows the nesting of the avifauna.

- Preserve hydraulic spaces
- Lower the sill in order to free sediment transport and improve the length profile of the river
- Vegetation management to maintain wide spaces
- Care the little valley “vallons obscures” with vegetation to minimize flood risk

The power plants operator, RWE, is studying solutions who permit eels and fishes to go easier upstream and downstream. For exemple a dam which can “disappear” when flood exceeds 80 m^3/s.