

Report of executed work

Restoration of the Vallicrosa stream at the section of Font del Pic in Sant Hilari Sacalm, Girona.

Project author and execution: Naturalea

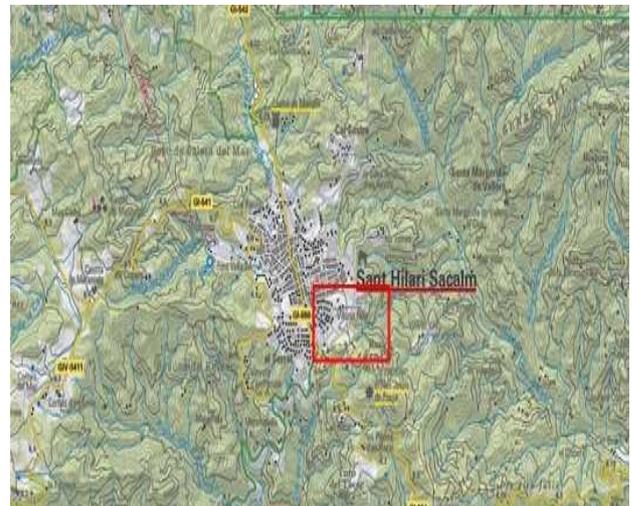
Client: Sant Hilari Sacalm City Council



INTRODUCTION

The location of the riverside object of the present project is the section of the Vallicrosa stream where it flows through the municipality of Sant Hilari Sacalm. In the intervention area at Font del Pic, there was an abandoned water bottling plant.

The proposed works to improve the riverside are focused on the hydraulic public domain, understanding this as the area public occupied by the river channel and the private or public lands that surround and integrate the biological corridor associated to the river, the riparian vegetation and the floodplain.



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1. Removal of the walls and structures of the old bottling plant

1.1. Removal of debris and waste from the channel

The structures were deconstructed and transported to a managed landfill. Next to the fountain, the action was carried two meters away from the current wall that connects with the slope. The wall was a result of a previous work by the City Council. The whole area around the stream was finally free of walls, foundations or any structure that was not original to the morphology of the stream.



Image of the channel before the intervention



Image of the channel after the intervention

2. Transfer of the collector that currently circulates hanging from the wall

2.1. Collector transfer

The collector is currently hanging from one of the walls along the river and must be moved behind its area of influence. This is a minor work, as the affected section is not very long, but it was essential to be able to carry out the previous action.



3. Works to improve the vegetation structure along the entire river

The torrent still has a section with riparian vegetation but it has also suffered the impacts of being next to a town. Sant Hilari City Council has controlled future impacts through a fence near the building. The works to be carried out are mainly the removal of exotic species, followed by formative pruning and removal of dead branches and clusters of sedimentary materials. The obtained material will be used to make dead-branch fascines to stabilize the slopes and favor the growth of trees.

Along the whole river, the channel was full of dead branches and clusters of sedimentary materials, which were removed from the area by manual means, about 4m³. Three black locusts (*Robinia pseudoacacia*) located on the left bank were also removed. They were eliminated by mechanical means of extraction, including the aerial part and the roots.



4. Restoration of the margin of the fountain formerly collected by the wall

This is the most problematic margin as it is necessary to continue the reconstruction of the section on some river slopes present before and after, with a slope of about 70°. The conditions of this slope were taken into account when defining the interventions:

- Height of 4 meters with a slope between 65-75°.
- Constant flow in an upper section of a river; which means easy erosion of the margins at the base.
- The area will be shaded by the trees surrounding the fountain esplanade, and although many of the trees were replaced by riparian species, their future will be shady.

For all the reasons explained, it was decided to build a double-walled cribwall or Krainer with two levels of willow and alder.

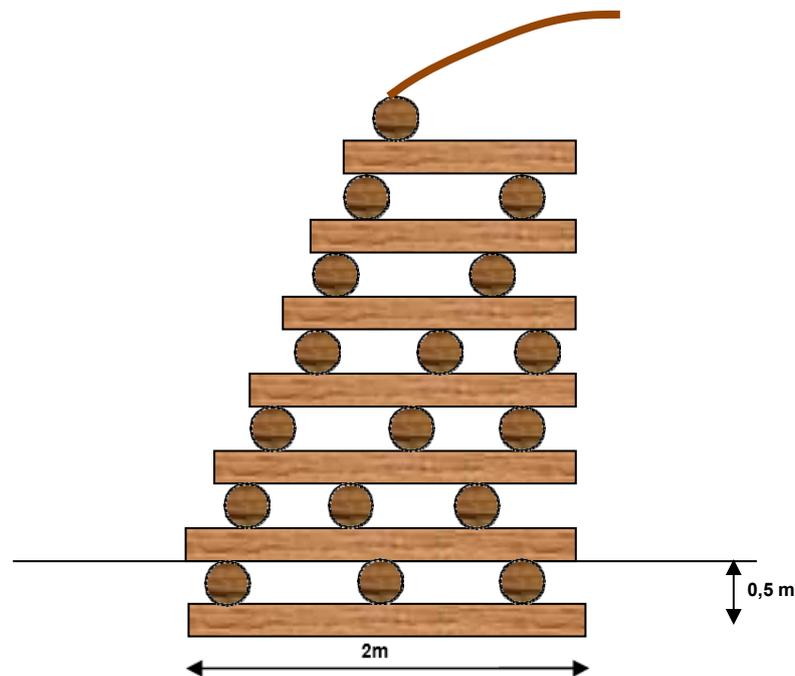
4.1. Excavation for the installation of the soil bioengineering structure

In order to be able to build the soil bioengineering structure, it is first necessary some previous preparation works at the area, mainly an excavation to be able to fit the structure in, since it has a considerable size. In total, 240m³ of earth was moved.



4.1. Krainer construction

In order to stabilize and build river banks with a current speed greater than 4 m/s and susceptible to erosion, we proceed to the construction of a gravity wall formed by a cellular structure of wooden logs distributed in two walls, combined with the insertion of living plants. An area of 120 m² is occupied for the construction of the Krainer, with 12 levels in total (6 parallel and 6 perpendicular), 240 m.l. of live fascines and 1782 willow and alder stakes.



Scheme of the Krainer at the Vallicrosa stream



6. Restoration of the margin next to Sant Hilari formerly protected by the wall

At the margin of the spa, the slope fell to about 45°; again, a definition of the conditions is necessary:

- Height of 4 meters with a slope around 45°.
- Constant flow in an upper section of the river, equivalent to an easy erosion of the base margins.
- The area will be sunny, although the trend is to form a gallery forest.

If a slope of 45° has a solid base it can hold up naturally against erosion. There are species that resist better the passage of water because they fold completely without suffering significant damage.

It is interesting to highlight the fact that, when folded, these species prevent the soil from erosion, having a protective function. A good example is the yellow lily (*Iris pseudacorus*) with very deep roots adapted to the presence of water; they can grow at the first front of the channel. This strategy is very good for flooding phenomena, and is insubstantial when excavators modify river channels. Consequently, these native species have disappeared from many of the current river systems.



The technical challenge is how to introduce these species so that they develop their resistance capabilities from the first minute after their installation. Another important factor is that the planting and restoration works do not harm the stability of the current systems. This problem is taken care of using bioengineering techniques, with a presentation of the plant inside a permanent coir fiber roll structure. Specifically, we propose for this implementation the vegetated Fiber roll to offer some structure to the base of the slope.

Afterwards, the slope was re-shaped and sowed with a mixture of native species from the Montseny area and then covered with a coir mesh. This technique gives structure to the slope for the next 3 or 4 years, until the vegetation is completely established.

Finally, shrubs and trees will be planted at the top of the slope.





6. Improvement of the riparian structure of the margins not affected by the old wall

The rest of the improved sections of the stream have numerous erosive processes and evident problems arising from them. Therefore, planting and consolidating the soil structure is considered a necessity until the species are fully adapted. In this line, the proposal includes the consolidation of the margins with dead-branch fascines and the subsequent planting of trees, shrubs, herbs and some helophytes.

6.1. Reforestation

The riparian forest is a rich community made up of many species because of its location in a particularly favorable area for life thriving. A mature riparian forest is an ecosystem often crowded with trees, shrubs, vines, birds, amphibians, reptiles, myriapods, beetles and a long list of other genera.

The aim of the present intervention is to favor the development of potential plant species in those sections near the river that today host some generally isolated specimens within the working area. Some of them are the last representatives of an ancient riverside community.

It is very important to choose the right species and their distribution in the area, and it is necessary to let them adapt to the microgeographical conditions of the river. The effects of the community growth on the margins already consolidated by herbaceous species that tolerate little shade should also be taken into account.

The community of the area consist in alder (*Alnetum catalaunicum*) and willow (*Saponario salicetum-purpureae*). The planted species (80) were the following: *Alnus glutinosa*, *Corylus avellana*, *Cornus sanguinea*, *Sambucus nigra*, and *Salix eleagnos*.



6.2. Assembling of dead-branch fascines

The more unstructured points of the slope were consolidated with dead-branch fascines, made with the material obtained from clearing the area. The aim was to improve the structure of the margin and as a supplement to the main action, the planting of the riparian forest.



Fascines at the moment of installation



Fascines 6 months after the installation

7. Naturalization works of the riverbed or low waters channel

In order for the deconstructed section to look the same as the natural sections upstream and downstream, the niches associated to the channel should be improved and the water oxygenated. Therefore, the proposal for this area consists of the installation of stone blocks.

7.1. Installation of stone blocks

To carry out this action, stone blocks with the same lithology and coloration as the natural sections will be used at the recovered sections, along 40m of the riverbed, using a total of 10m³ of stone.

8. Other works for the improvement of the area



8.1. Hydromat

The hydromat of the HydraCX2 type with cotton fibers is a biodegradable hydraulic sowing application for vertical slopes with an immediate need for protection.

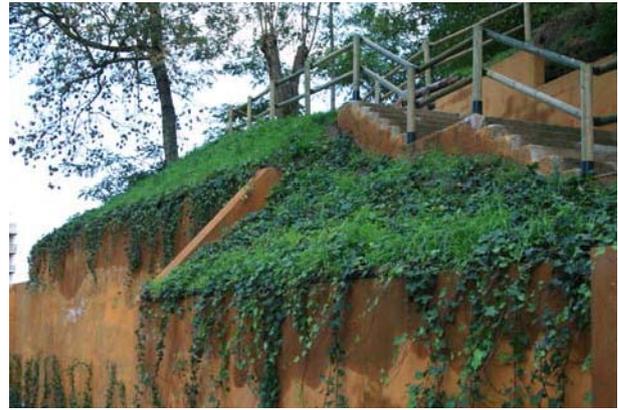
This hydromat creates a continuous layer of protection against surface erosion. It is porous, absorbent, flexible and accelerates vegetation growth. It is a technique that can replace temporary erosion control mats. The hydromat was applied once all the earthworks were completed.

8.1. Drainages with permanent geogrid

Permanent geogrid drainages were consolidated at the area. It consists of a green pipe system that combines the sowing of herbaceous species (for setting up a vegetation cover) and the installation of a permanent geogrid type C350 Vmax adapted to hydraulic conditions.



8.2. Restoration of slopes and consolidation of the path



KEY WORDS: habitat diversification, stream recovery, slope protection, soil and water bioengineering.

APPLIED TECHNIQUES: Multi-specific grassland (Plant Pallet), vegetated Fiber roll, Krainer cribwall, planting, organic coir mesh, cotton hydromat, permanent geogrid, drainage channels with permanent geogrid