

ECOTECHNIC METHODS

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1. Description of the ecotechnic solution proposed for Jijia watercourse sector on the Iacobeni village territory.

There are a variety of channels with standing and flowing water along the rivers. River water quality can quite often be improved through these channels by connecting them to watercourses.

In Iacobeni, there is an anthropogenic flowing channel (fig.1.1) and a long-standing water meander (fig.1.2) which is fed by underground water and rain water.

The current situation (before ecological restoration) of the area set (anthropogenic channel Jijia and meander) can be seen in (fig.1.3).

The method to be now presented is to establish connectivity between the watercourse and the standing water channel by combining an ecological and engineering methods in order to create wetlands and riparian areas, as basic elements in the local ecosystem functionality.

For the ecological restoration of the river sector in Iacobeni, the following connection method is proposed, namely: the connection is made through a bank of pipe ducts to Jijia watercourse, by the first third of the old meander, having as finality, the operation of the new local ecosystem created. The connection with Jijia River will be done at the end of downstream meander through a breach fitted with a valve duct pipe into the bank that separates the meander and the stagnant water (Fig. 1.4). The duct pipe will pass under the dam.

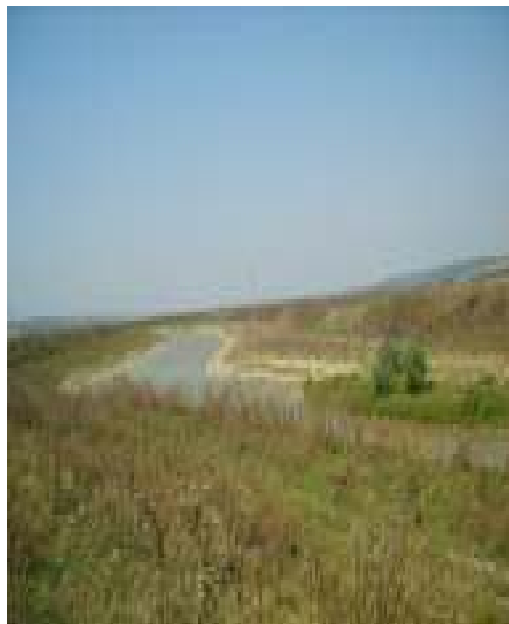


Figure. 1.1 The Jijia watercourse

The engineering terms (rate difference between the meander and watercourse, the quantity of flow, the soil morphology, etc..) contribute to this connection between the meander and Jijia watercourse.



Figure.1.2 Sector in the first third of the meander (upstream end)

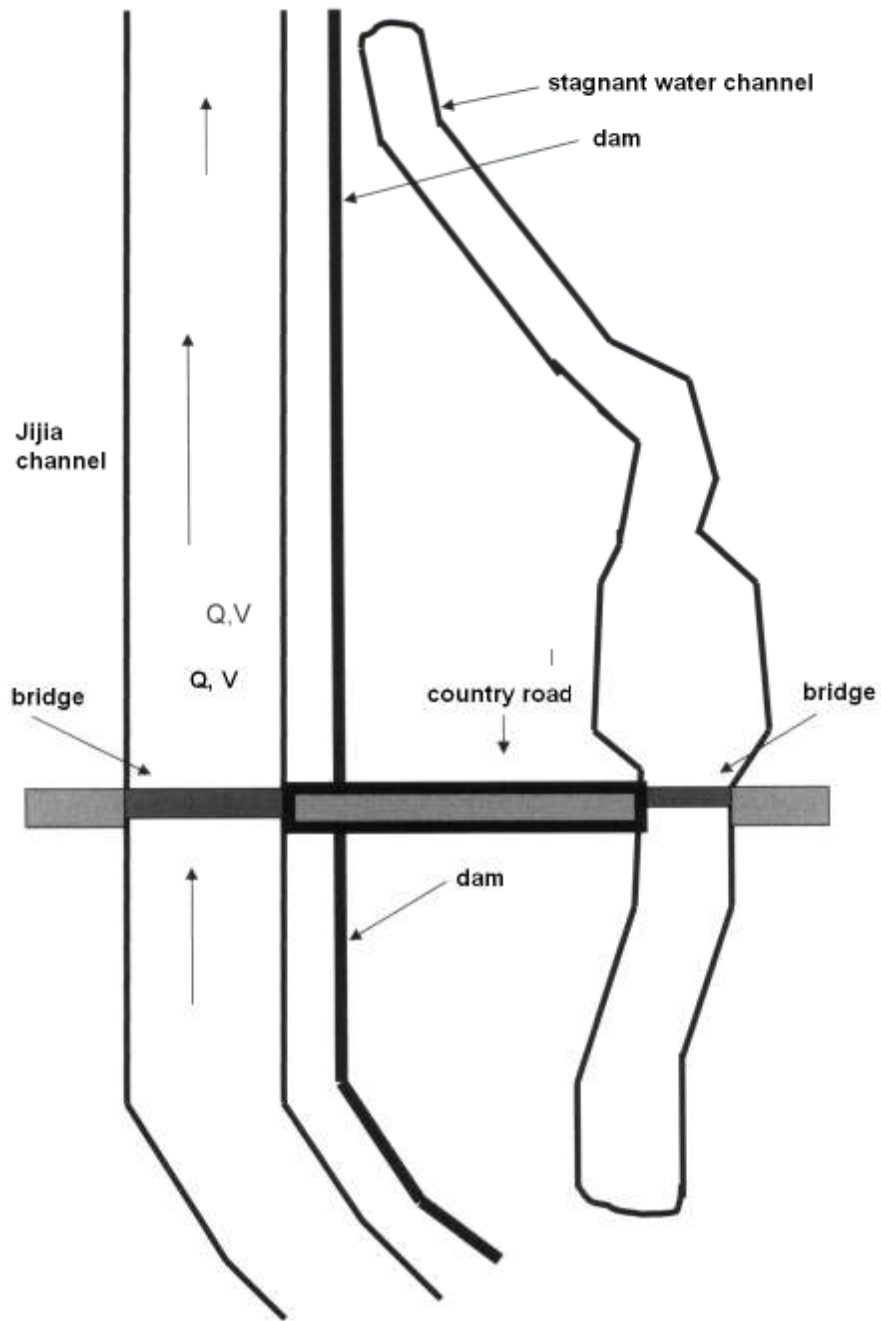


Figure.1.3 Channel Jijia and the meander before the ecological restoration
 present situation
 - orientative scheme -



Figure. 1.4 Sector in the last two thirds of the old meander (downstream end)

The duct pipes that will supply the old meander with water coming from the Jijia river are arranged in semicircle and in line on the entire surface of the meander's left bank in order to build and maintain the wetland and the riparian area. There are two existing cases as regards the water outlet through a duct pipe:

- a) The duct pipes, even if they are located a few inches below the wet area and open onto the meander's water body, are equipped with holes arranged in line exactly in front of the wetland to keep it functioning.
- b) If the opening takes place directly into the water body near the old meander substrate, the holes arranged in line (first case) are no longer valid. In this case the connecting duct pipes capturing water from Jijia River are continued by other welded duct pipes, through which a lower flow rate will pass, functioning as those in the second solution. Amount of the water flow into the duct pipes should be 1 / 3 higher than the water flow opened in Jijia River through the duct pipe situated at the downstream old meander's end. (Fig.1.5)

Please note that the old meander or actual meander are the same thing. Due to lack of water and aquatic and riparian vegetation on the Jijia water course and on some of its meanders, the erosion is quite pronounced. Erosion supplies the river with materials in suspension. Without appropriate measures, banks have lost vegetation, resulting an artificial-looking and biotopes that provide food and reproduction of fish and aquatic birds are threatened. Erosion of river banks without the vegetation support will contribute to increasing the sludge formation and the amount deposit of clogging, therefore blocking the normal development of underwater life.

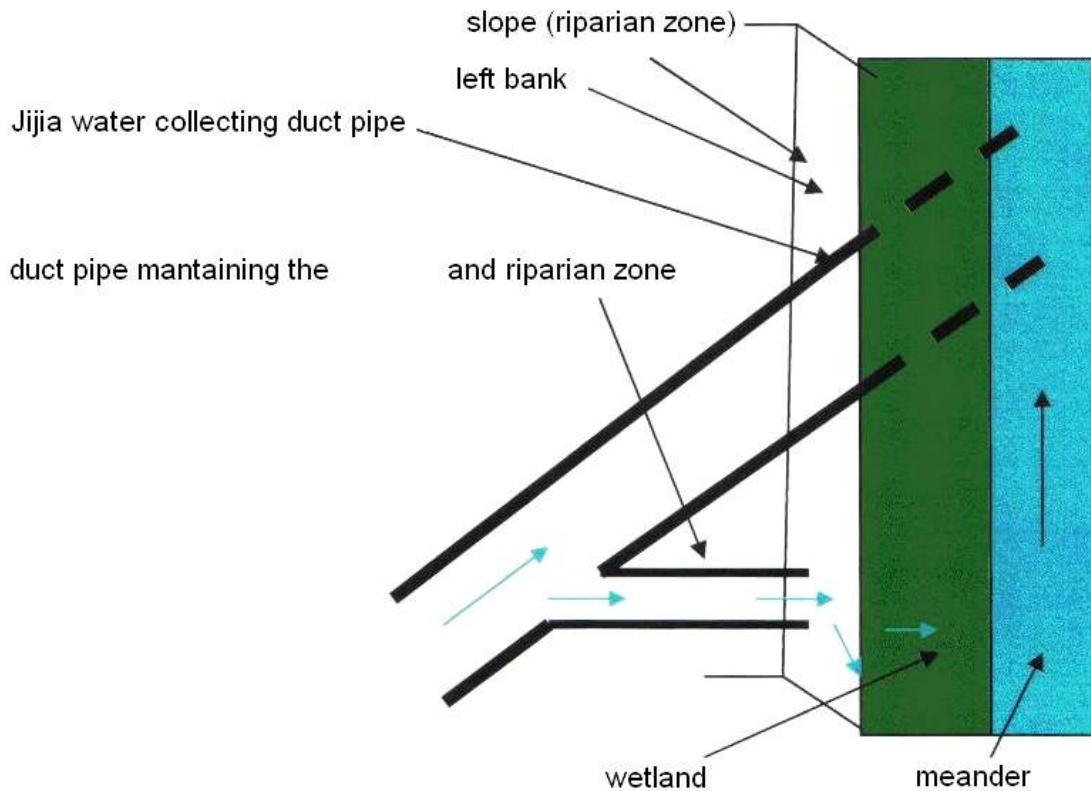


Figure. 1.5 Sector in first third of the meander after the ecological restoration
longitudinal section
-orientative scheme -

The left bank of the meander will be leveled up to the bridge, from the point where bank erosion is most pronounced (fig.1.6). This will be done before inserting pipes under the dam. After the bridge that separates the first third of the meander, the left bank leveling (fig.1.7) towards the further water flow direction will be done into the same point where erosion is most advanced.

Planting fast-growing woody species (alder, willow, etc..) is recommended for ground stability; planting higher species is not recommended, as they stagger under the influence of wind causing subsidence cracks in the soil and leading to landslides. Also, no swing-rooted grass species are recommended, as they can ease the slumping; but fascicular rooted grass species can be used (sedge, fescue, etc.). Species that prefer soil moisture and remove large amounts of water through the transpiration process will be used.



Figure. 1.6 Advanced erosion on the right bank of the meander



Figure.1.7 Sector in the last two thirds of the meander

If on the first third of the meander, the left bank becomes uniform with an inclination of 60 degrees, the left bank of meanders, in the direction of water flow, becomes a slope (45 degrees) on the last two thirds, especially for planting and developing root mass of herbaceous and woody plants against the advanced erosion of the bank. On the first half, partly located in the body of water, (reed, sedge, bulrush, fescue, etc..), in the inclined plane created, and on the last half of the inclined plane, woody vegetation (silver poplar, alder, willow, etc.) will be planted. (fig.1.8)

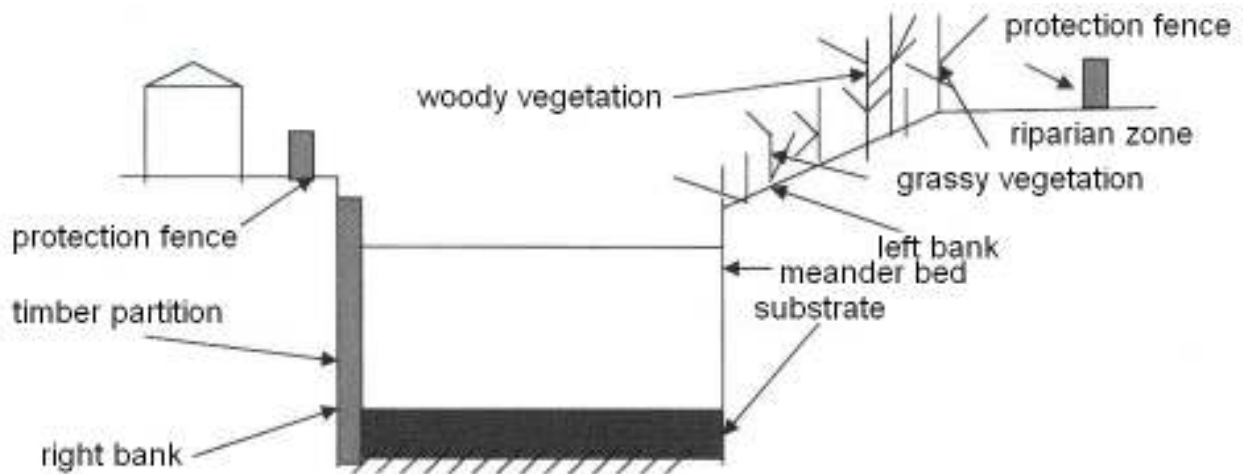


Figure.1.8 Cross section representing the last two thirds of meanders after the ecological restoration.

- orientative scheme -

Two lines will be interconnected on the left bank base, at the first third of the meander and inside the wetland and also on the bank, having an inclination of 60 degrees, where willows and alders will be planted; in the immediate vicinity of the bank, a line of acacia will be planted up to the bridge. at distance of one meter, therefore the bank will be stabilized in two directions through the root mass. (fig.1.9)

Due to erosion and drought, *the right bank* of the meander's first third must be built in soil steps having about the same size and being similar to gabions and their functions, the height h' and width l' . The first step, entirely positioned within the water must be a few inches below multi-annual average level of water in order to create a linear wetland. The second step, at a height of about $h' \approx d' \approx 50$ cm from the first sector will be created to support the riparian bush (ex). The average slope is ≈ 1 ‰. Steps will be built throughout the sector length (≈ 100 m), each step having $h' \approx 50$ cm height and $l' \approx 1.5$ m width (fig.1.9). Vegetation will be planted on such steps, depending on plant water needs, as follows:

- on the first step, annual and perennial herbaceous vegetation (*Lolium perene*, *Festuca pratensis*, *Agrostis stolonifera*, *Phragmites australis*, etc.) can be planted
- on the second step alder (*Alnus glutinosa* - black Alder) and silver poplars can be planted.

Widths and edges of steps (5 cm) will be surrounded by water impact-resistant plastic, and the last step should not get beyond the bank height. Steps will be constructed by mechanical equipment but also by metal systems for meander water redirection supported by a plastic system until over 50% of both herbaceous and woody vegetation (fig.1.9) have been grown. Wetlands should be linked to riparian areas where possible, because, by their multiple features, they greatly improve the effectiveness of newly developed ecosystem, but also the adjacent areas of the riverbed sector especially selected for the method presented.

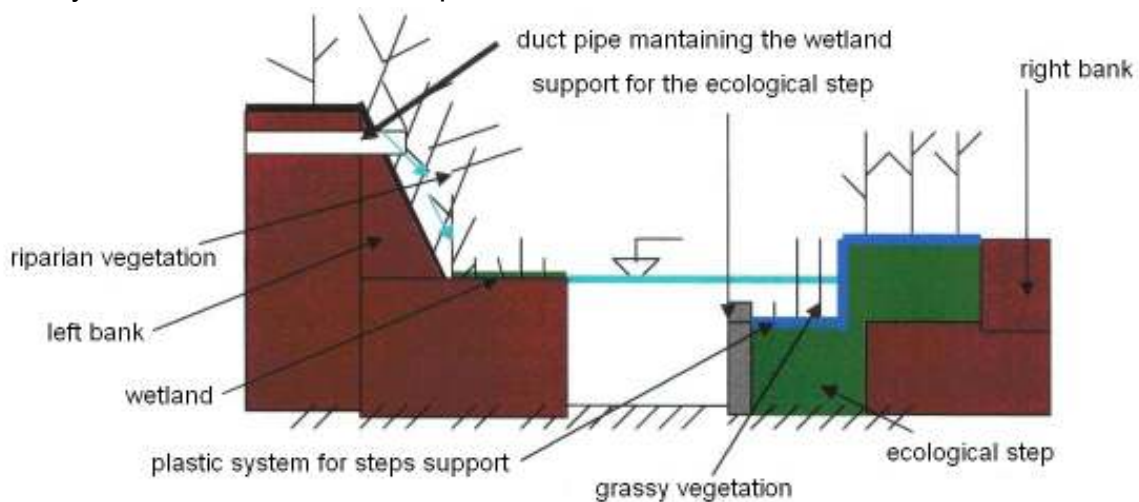


Figure. 1.9 Cross section representing the first third of meanders after the ecological restoration.

- orientative scheme -

By the means of some stainless steel or resistant plastic duct pipes (fig.1.10) fixed inside the soil surface, the watercourse (Fig. 1.1) and the old meander / channel with stagnant water (Fig. 1.2) will be connected.

It is very important to observe the soil morphology and its capability of maintaining water as to create wetlands and riparian areas. Water will penetrate the duct pipes and the breach created into the right bank of Jijia River. After fixing the duct pipes or pipes by the means of some mechanical machines used for drilling in the river bed, and also by using some metal structures in order to redirect the watercourse where the right bank of the Jijia watercourse will be drilled; grills will be installed at the bottom end of each pipe to protect pipes against a possible obstruction with substrate material in suspension. Flow control will be made by valves, attached to all duct pipes. Right bank of the meander will be protected against erosion by timber partitions set at about 20 m after the bridge (Fig. 1.11) towards the water flow.

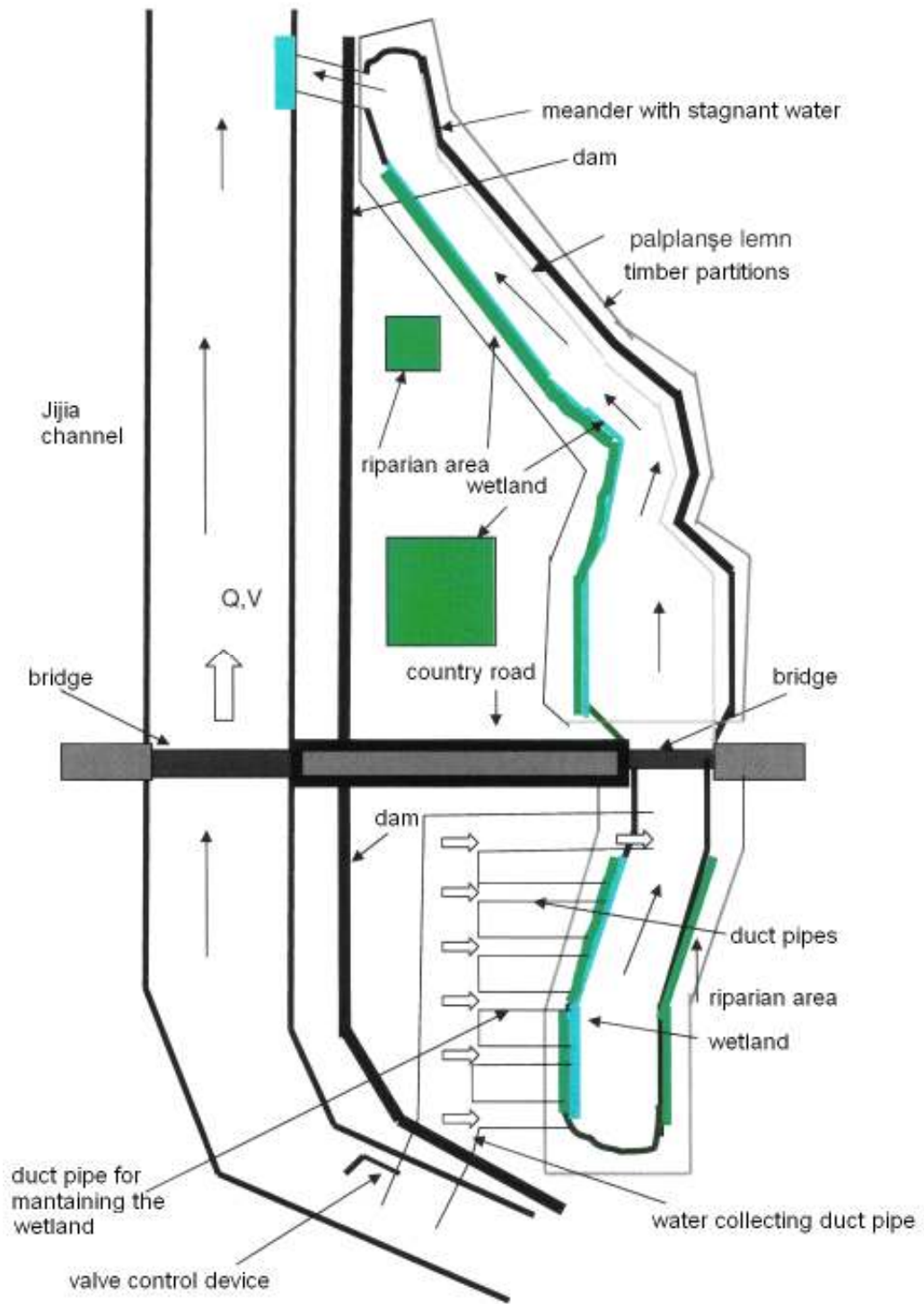


Figure.1.10 Jijia channel and old meander after the ecological restoration
 - orientative scheme -



Figure.1.11 Sector in the last two thirds of the meander

2. Description of ecotechnical method, proposed for Hartibaciu River along the sector in Agnita, Sibiu county.

Along the sector which passes through the city of Agnita, Hartibaciu River is almost completely dammed (fig.2.1, 2.2) with solid concrete walls. Because of sources of pollution (industrial and domestic) from the city of Agnita (fig.2.3) and of a complete lack of riparian vegetation, the basic elements that support the operation of a lotic ecosystem were almost totally destroyed. There are many sources of pollution that penetrate the waters directly into the river Hartibaciu without being treated. This water sector was chosen because it is almost completely altered by the Hartibaciu water course, within the city of Agnita, and also because of various species of birds and fish's habitat destruction downstream of the city.



Fig.2.1

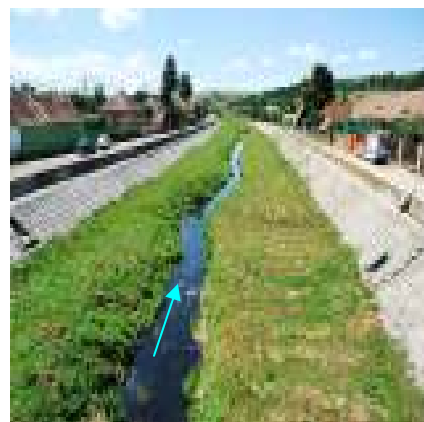


Fig. 2.2 (source: <http://ro.wikipedia.org>)

Figure. (2.1, 2.2) Hartibaciu River



Figure. 2.3 Pollution source, Hartibaciu river

In order to finalize the ecological reconstruction of Hartibaciu river, the new river bed should be protected from any source of pollution, so the sources of pollution (city polluted water) must be captured through parallel channels built inside the concrete banks (Fig. 2.4). Sizing parallel channels will be done according to the evacuated water flow (industrial and domestic) into the Hartibaciu River. In this case, it is not necessary to perform the river banks un-concreting procedure, as the Hartibaciu River can be rebuilt ecotechnically within these banks. The river water quality at the exit of Hartibaciu, Agnita is the fourth category. Hartibaciu River flow area will be constructed as meander belts by wooden concrete to resist the floods. In the immediate vicinity of Hartibaciu River, wetlands will be built and link to the river through a system of channels (Figure 2.5).

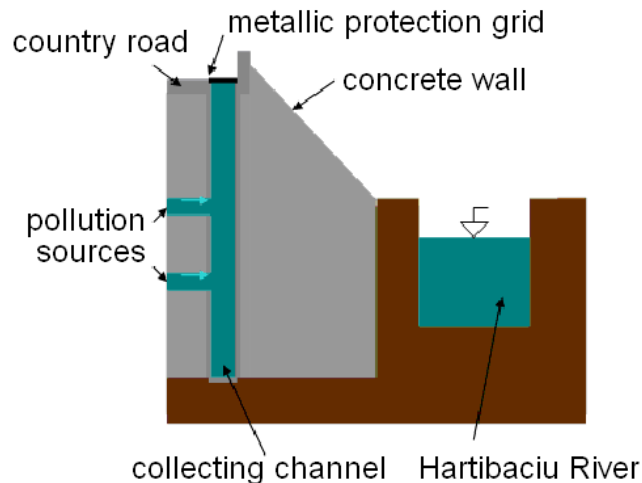


Figure 2.4 Collecting channel located on the right bank of Hartibaciu River
- orientative scheme -

A meandering river bed with green sides, having the form of an inclined plane (river Cibin) are necessary to be created. Water flow area will be made of wood or concrete according to regional flood frequency and amplitude. Various fast-growing woody species (alder, willow, etc.) but also herbaceous species having fascicular roots (sedge, fescue, etc.) will be planted in line or in the form of rhombs, along these banks. The banks will be filled up with soil up to the middle height of the dam protection (Figure 2.5).

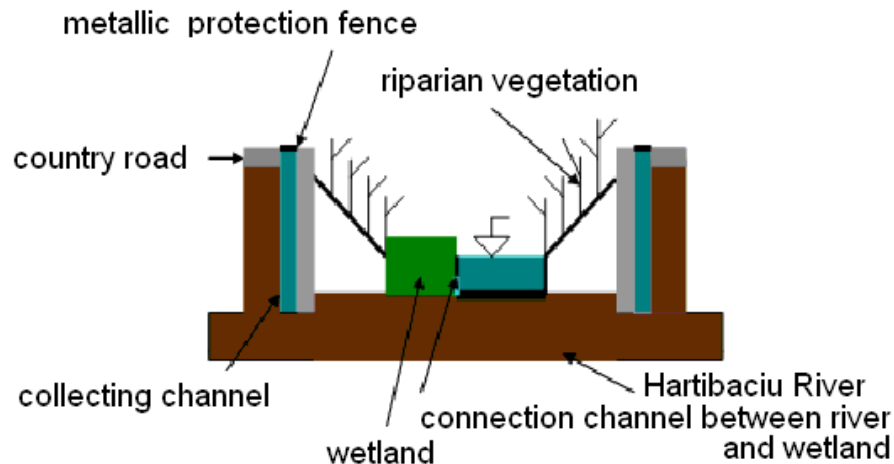


Figure. 2.5 Ecotechnical arrangement of Hartibaciu River in the city of Agnita - cross section
- orientative scheme -

This ecotechnical method is suggested for the riverbed sector effective starting to 400 m length up to the complete river sector arrangement. The river sector which passes through Agnita will be completed at the exit of the city. The collecting channels must have the same slope as the Hartibaciu River. The ecotechnical reconstruction of Hartibaciu river will also continue downstream the city of Agnita, having about 500m length and creating riparian areas and wetlands.

According to GD 1284/2007, Hârțibaciu Plateau (fig.2.6) has been declared a special area of avifaunistic protection becoming a bird protection area, as a part of the European Natura 2000 network in Romania. This SPA covers the territory of the counties of Brasov, Sibiu and Mures covers 39 municipalities and five cities of Agnita, Dumbraveni, Fagaras, Sighisoara and Rupea, being in size, the second area in the country, after the Danube Delta. Most of this area is in Sibiu County, in the valley of Hartibaciu (fig.2.7).



Figure. 2.6 Hartibaciu Plateau - Satellite images
 (Source: Landsat Image © NASA)

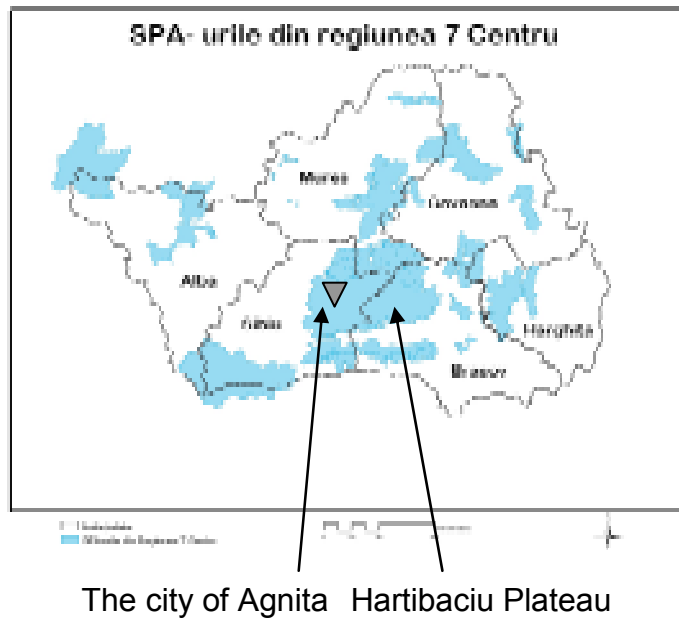


Figure.2.7 Hartibaciu Plateau RO SPA 0099

(Source: <http://www.arpm7c.ro/img/spa%20web.jpg>)

The aim of this special area for birds protection has been the preservation of 32 bird species: *Alcedo atthis* (Kingfisher), *Anthus campestris* (Tawny Pipit), *Aquila pomarina* (The Lesser Spotted Eagle), *Aythya nyroca* (The Ferruginous Duck), *Botaurus*

stellaris (The Eurasian Bittern), *Bubo bubo* (The Eurasian Eagle-owl), *Caprimulgus europaeus* (The European Nightjar), *Chlidonias hybridus* (The Whiskered Tern), *Chlidonias niger* (The Black Tern), *Ciconia ciconia* (The White Stork), *Ciconia nigra* (The Black Stork), *Circaetus gallicus* (The Short-toed Eagle), *Circus aeruginosus* (The Marsh Harrier), *Circus cyaneus* (The Hen Harrier), *Crex crex* (The Corncrake), *Dendrocopos leucotos* (The White-backed Woodpecker), *Dendrocopos medius* (The Middle Spotted Woodpecker), *Dendrocopos syriacus* (The Syrian Woodpecker), *Dryocopus martius* (The Black Woodpecker), *Egretta alba* (The Great Egret), *Falco vespertinus* (The Red-footed Falcon), *Himantopus himantopus* (The Black-winged Stilt), *Lanius collurio* (The Red-backed Shrike), *Lanius minor* (The Lesser Grey Shrike), *Lullula arborea* (The Woodlark), *Nycticorax nycticorax* (Black-crowned Night-heron), *Pernis apivorus* (The Honey Buzzard), *Philomachus pugnax* (The Ruff), *Picus canus* (The Grey-headed Woodpecker), *Sterna hirundo* (The Common Tern), *Strix uralensis* (The Ural Owl) și *Tringa glareola* (The Wood Sandpiper). The area hosts a significant number of typical species. Here, the most important population of The Lesser Spotted Eagle and The Honey Buzzard has its nests, the highest density being achieved at the south of the Valley of Hartibaciu. The Corncrake (*Crex crex*) population is globally significant (over 20 pairs).

Downstream the city of Agnita, there are several areas where dozens of species of protected birds and five species of fish (*Barbus meridionalis*, *Cobitis taenia*, *gobio Kessler*, *Rhodeus sericeus amarus*, *Sabanejewia aurata*) are hosted but, due to decreasing pollution, their number decreased drastically. Riparian vegetation destruction, disposal of garbage and building various illegal constructions along the River Hartibaciu banks led to additional pollution of the river and determined disappearance of many habitats for various species of birds. Therefore, downstream the city of Agnita, near the city, rectangular artificial wetlands to purify the polluted water from sewers must be constructed (fig.2.8). A part of the water entering the wetlands will reach the Hartibaciu River through the connection channels. (fig.2.8).

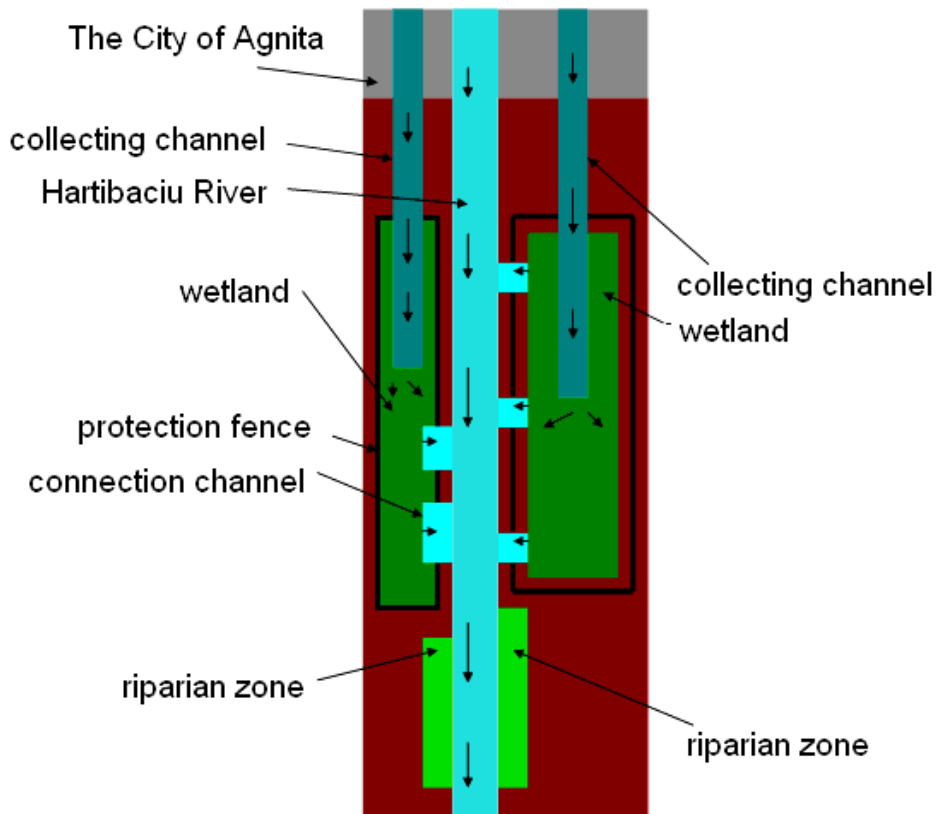


Figure. 2.8 Ecotechnical arrangement of Hartibaciu River downstream the city of Agnita
 - cross section
 - *orientative scheme* -

Downstream the wetlands, riparian zones extremely important to stabilize banks will be developed (Fig. 2.8). All these ecotechnical arrangements using the ecological scrubber system of wetlands and ripariene zones will cause a change in water quality of Hartibaciu River. This will generate an increase in local biodiversity of the river, which is essential to ecosystem functioning of these areas. Wetlands and riparian areas must be protected using metallic fences. An undeveloped ecotechnical arrangement of this river completely destroys the habitats of various species of birds and fish downstream the city.

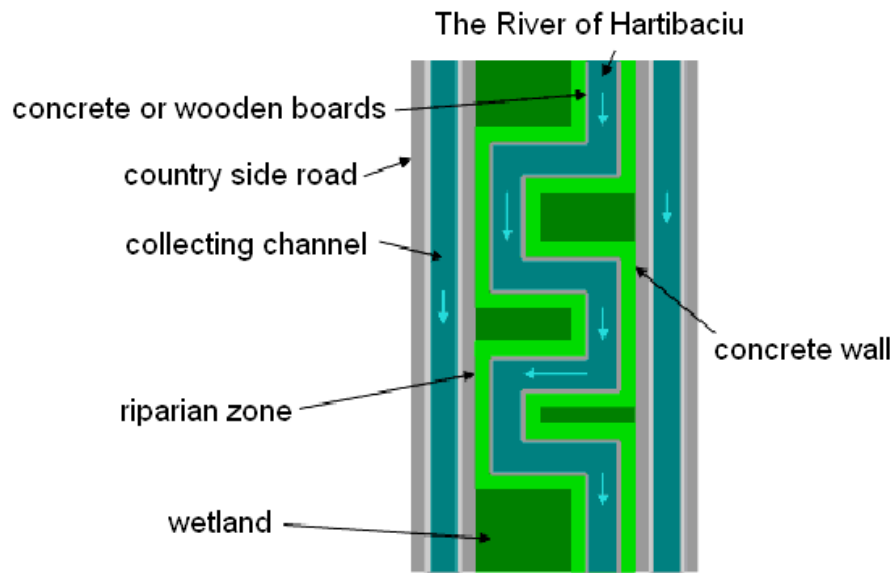


Figure. 2.9 Ecotechnical arrangement of Hartibaciu River in the city of Agnita
 – cross section
 - orientative scheme –

Ecotechnical arrangement of Hartibaciu River in the city of Agnita will lead to water quality improvement by the means of bioconversion and accumulation, production of organic matter for aquatic ecosystems and will safely preserve flora and fauna for the habitat (fig.2.9). Any ecotechnical arrangement of Hartibaciu River along the city of Agnita has no ecological value as long as there are sewer overflows into the river.

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