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SOLUTION TO CREATING A FISH MIGRATION SYSTEM OVER THE BOTTOM/DISCHARGE SILL ON THE SOMEŞUL MIC RIVER NEAR THE TOWN OF GHERLA

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Abstract
Longitudinal connectivity within a hydrographic network refers to the ways in which organisms move and also to energy and material exchanges located throughout the water. Discontinuation of longitudinal connectivity of watercourses caused by waterworks (sills and dams) has a major impact on sediment transport, hydrological regime, downstream moving and biota migration. Hydromorphological elements (river continuity), as well as chemical, biological, physicochemical elements characterize the ecological status of waters. The proposed engineering solution for fish fauna migration upstream – downstream of the discharge / bottom sill near the town of Gherla supports the need to put into practice such measures planned by the Water Framework Directive.

Keywords Somesul Mic, Gherla, fish migration, solution

INTRODUCTION

The bottom sill near the town of Gherla is located on the Someşul Mic River 160 downstream of the bridge Gherla and close to (≈ 10 m downstream) the confluence with Canalul Morii (L = 4 km) which crosses the town of Gherla from south to north (Fig.1).

The average speed at the bottom/discharge is 0.4 m/s. The Someşul Mic River has a length of 165 km, a basin with an area of 3804 km² and an annual average flow of 20.88 m/s, which includes the Somesul Cald River flow, where the first three hydropower steps are arranged and that flows upstream of the town of Gilău. Development of water use services in the

Someşul Mic River basin and especially in Cluj area has led to overcoming the possibility to ensure the necessary flow in terms of natural flow regime, which has been added to need to compensate for flow pulsation caused by future power plants upstream. (http://www.hidroconstructia.com).

Given that Romania is part of the European Union, it has the obligation to implement the provisions of the Water Framework Directive 2000/60/EC, transposed into Romanian legislation by the Water Law 107/1996 as supplemented and amended (Act 310/2004, Law 112 / 2006).

Figure 1 Bottom sill near Gherla town (Source: Google Earth, 2014)

Migratory species identified are Barbel (*Barbus barbus*) and Common Nase (*Chondrostoma nasus*). nase (Chondrostoma nasus) protected by Bern Convention (Appendix III), barbel (Barbus barbus)- rare species, protected Habitats Directive (Annex V), annex 4A of Low nr. 462 and Red List of RBDD)

On the left bank of the Somesul Mic River a rectangular concrete basin (basin I) will be built. It will have two water supply systems (an upper crenel and an opening at the base of the basin) and a single water removal system (by means of a rectangular-shaped crenel located on the surface of the basin). The basin I is provided with a protective metal grille above it. Water supply is performed via a penstock outlet upstream of the bottom / discharge sill and via canal II (Fig.2).

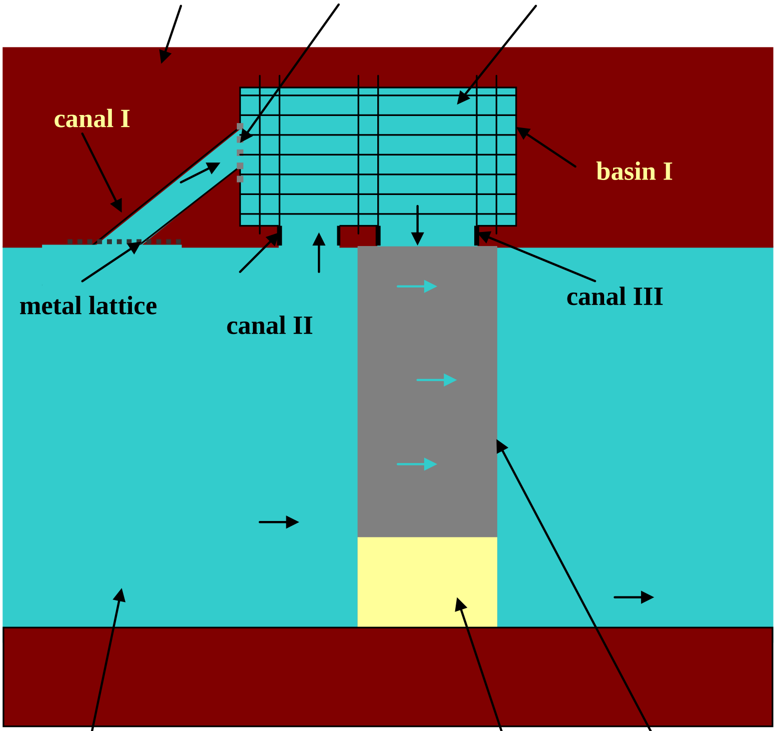

Figure 2 Positioning the three canals and the basin I- indicative scheme

The canal III connects with another rectangular canal (Fig. 3) for fish migration (module M1) which is fixed to the bottom sill near the town of Gherla. The length of this module ends at the dry and inclined area of the discharge sill (Fig.4). At the upstream end of the canal I a metal stainless grille is fixed blocking the fish and the floating bodies (Fig. 2). A concrete lattice is fixed at the downstream end of the canal in order to block the fish migration (Fig. 2).

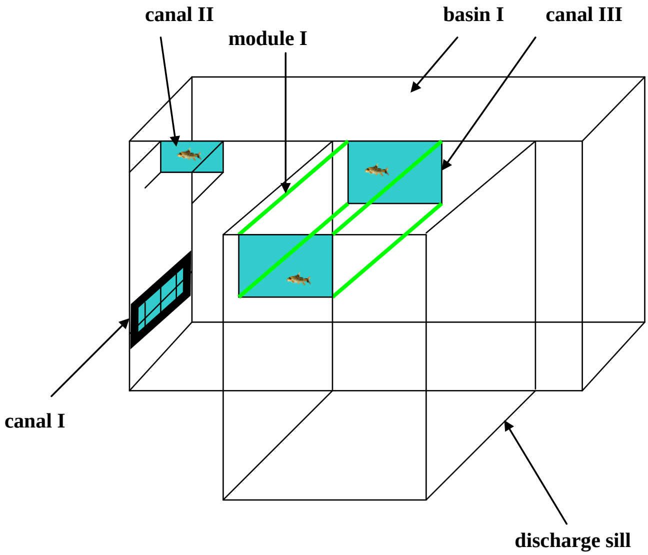

Figure 3 Positioning the first module (module M1) - indicative scheme

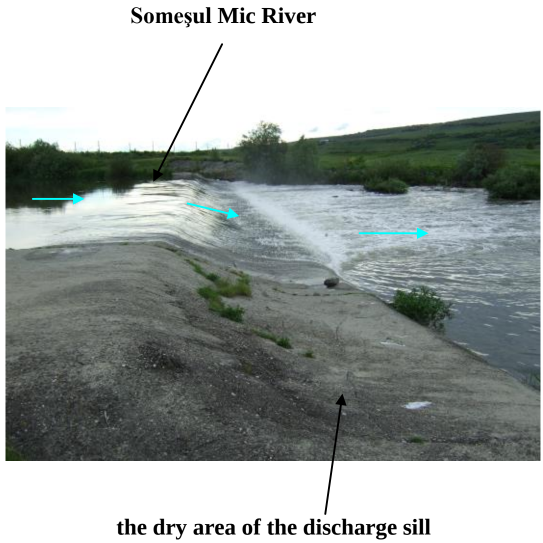

Figure 4 Discharge sill near the town of Gherla
(Photo: Costica Sofronie, ABA Cluj)

The module M1 will be fixed perpendicular to another module M2. The module M2 will be extended to the intersection between the Someşul Mic River and the discharge sill (Fig.5). Both modules are provided with protection metal lattice fixed to the metal hinges that allow their repair or unclog.

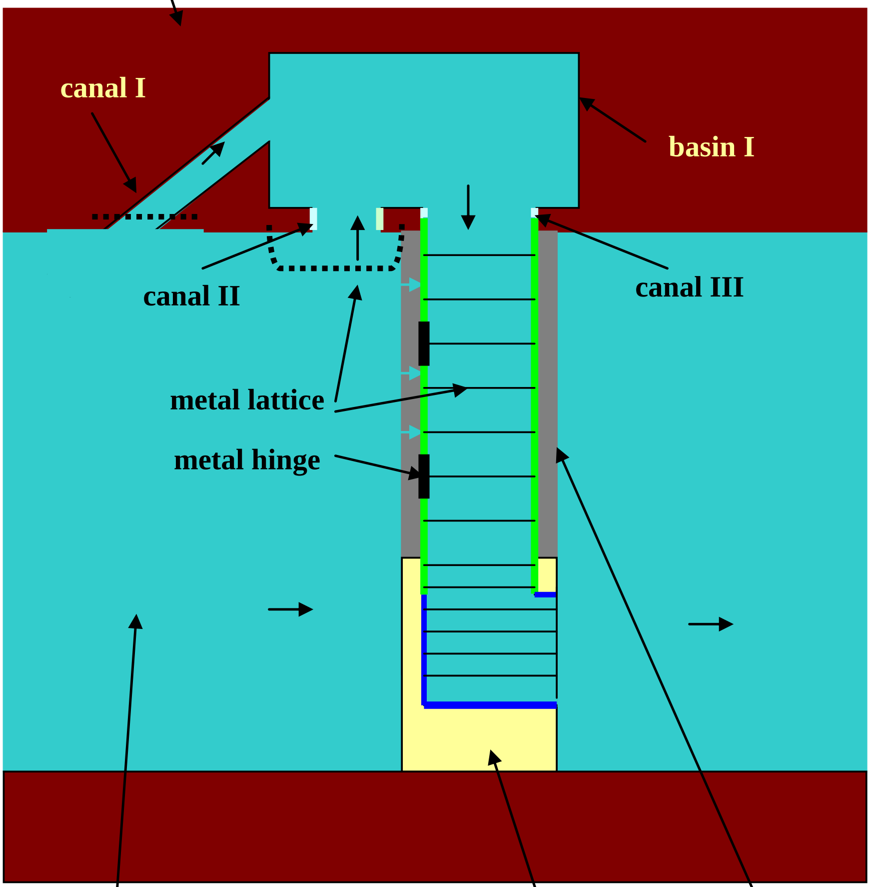

Figure 5 Positioning of the two modules M1 and M2 - indicative scheme

Fixing the M1 and M2 modules is done by using metal necklaces and metal bars (Fig. 6 and Fig. 7). The metal bars will have a diameter of 20cm and a height of 32cm for the first bar near the concrete basin and of 20 cm for the last bar next to the three connection basins. Thus water passes under M1 and M2 modules and the average distance between the two modules and the Someşul Mic River watercourse passing above the bottom sill is 10 cm, which provides safety for the two modules even at average flood magnitude.

Any stability plate welded to the bar and located inside bottom sill will have 20x30x20cm. The modules M1 and M2 concrete thickness is of 3cm. The bars will be fixed in the discharge sill at a distance of 1.5 m. All metal parts are stainless. Module M1 and module M2 will have a length of 25m and 1m, respectively. In order to prevent the floating bodies entering the canal II and being redirected a stainless semicircular lattice needs to be fixed to the canal II, at about 4m (radius semicircle) (Fig. 8). This lattice is about 80 cm tall and the average annual water level is half the lattice. Fish entering or leaving the canal II are not blocked by the metal lattice.

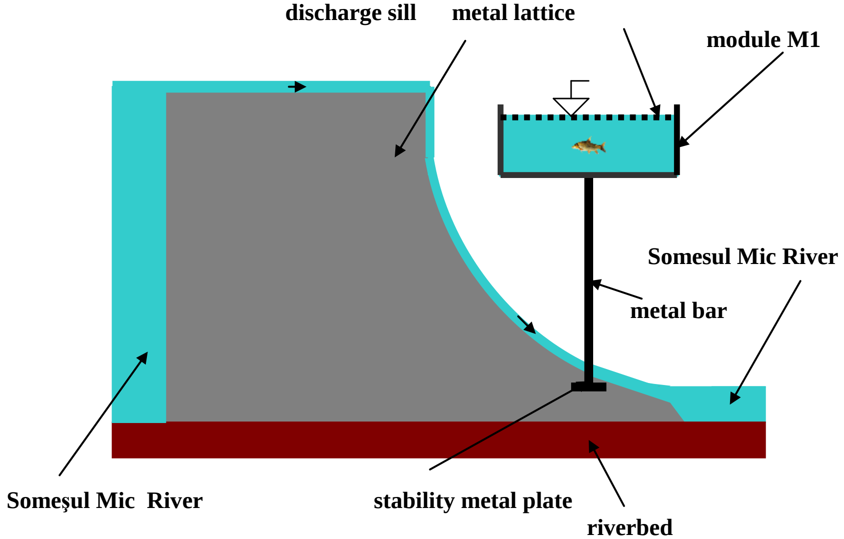

Figure 6 Fixing M1 and M2 modules to the discharge sill – indicative scheme

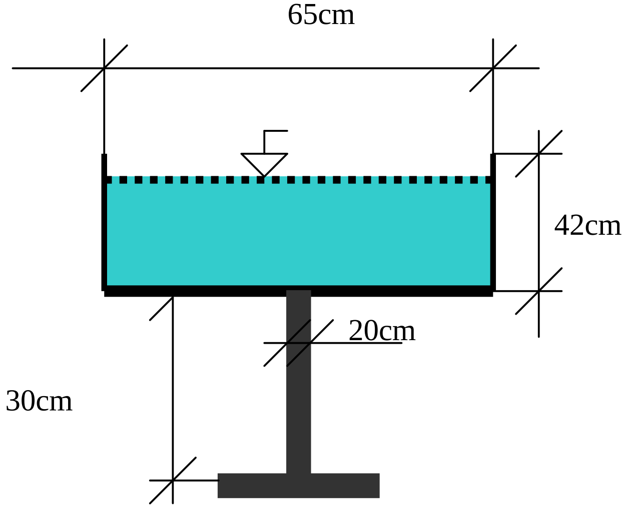

Figure 7 Dimensions of Module M1 – cross section-indicative scheme

Three rectangular parallelepiped basins connected altogether are fixed to the module M2, to the discharge sill but also to the riverbed so that the fish can climb up to module M2 (Fig. 8 and Fig. 9). All three basins are provided with metal lattice for fish fauna protection.

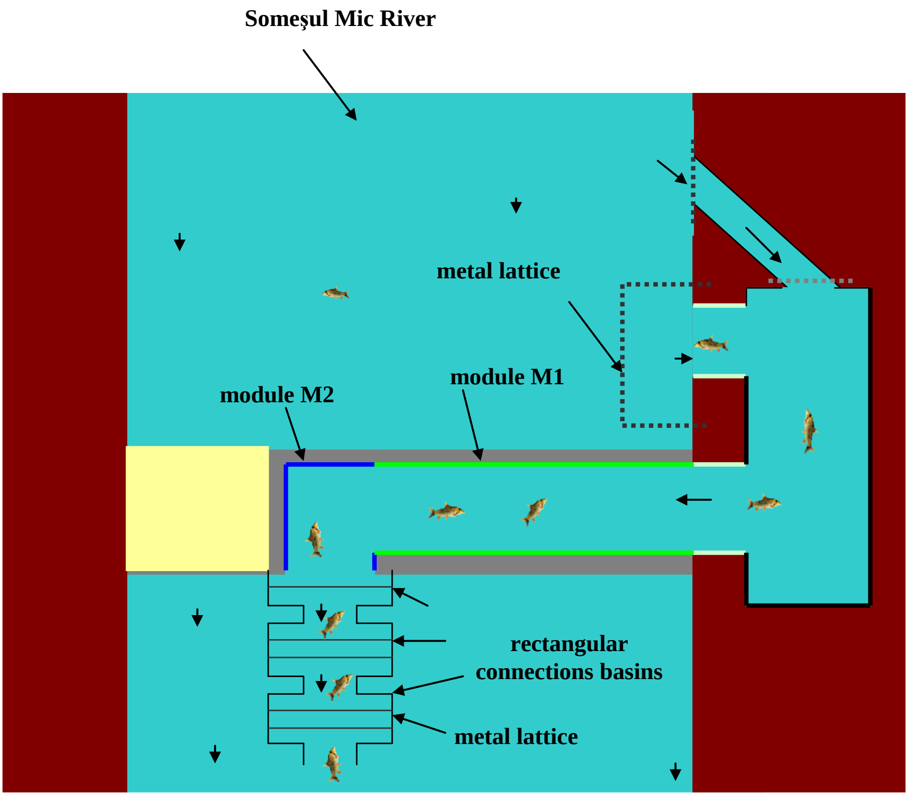

Figure 8 Positioning the three basins making the connection between the Someşul Mic River and the module M2

The first connection basin will have the following dimensions: about 2.20 m tall, 1.50 cm thick and 3m long. The second and third connection basins will have a height of 2.15 m and 2.10 m, respectively, and thickness and length are similar to the first basin (Fig.9). Connecting basins can also have a cylindrical shape (Fig. 10).

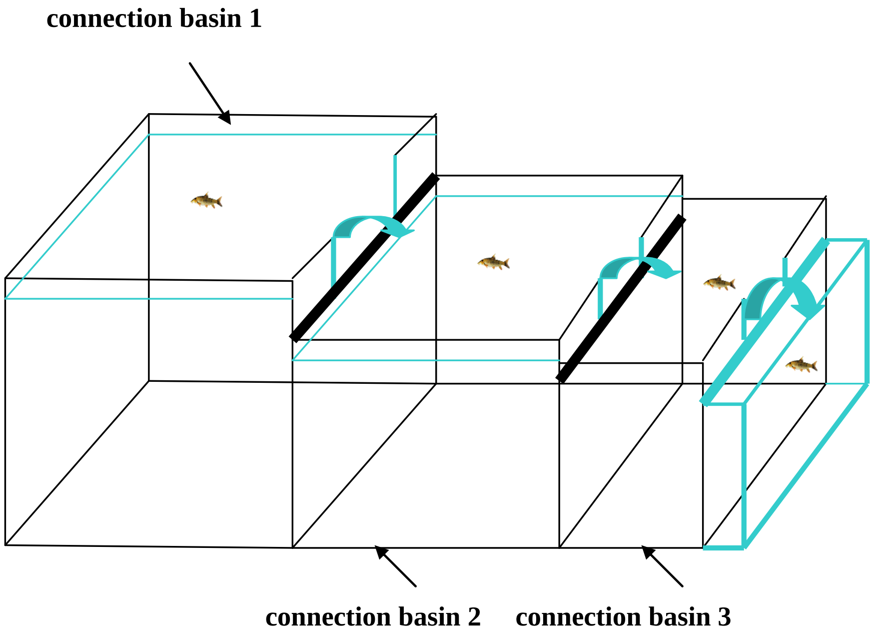

Figure.9 Connected basins – indicative scheme

Figure 10 Cylindrical connecting basins- indicative scheme
(http://www.confenv.com/projectsCaseStudiesJapanese.html)

Both module M1 and module M2 but also the canal III have a smaller slope than the one of the river in that area in order to facilitate fish climbing on them and their reaching upstream of the discharge sill at a speed of 0.32 m/s. The difference between the size of the system components set forth in the text and the actual sizing of system components in case of final account and completion of the project is insignificant and has no influence on the effective functioning of this system for fish migration above the discharge sill previously mentioned.

To completely avoid damaging of M1 and M2 modules in time and due to rampant increase in the the Somesul Mic River waterlevel above the discharge sill near the town of Gherla, the two modules will have other characteristic. After 30 cm, the first module will reach a 90° angle and after another ≈ 100 cm the Module I will be parallel to the discharge sill. Module I is parallel to the discharge sill, but is still above the water level (Fig.11). In this case, the Module 2 is the extension of Module 1. The connection basins will be positioned inversely, in the direction of water flow. In this case, the Module 1 length is smaller by at least three meters so that the smallest connection basin to be now positioned exactly on the same line with the first solution consisting of the two modules (Fig.12).

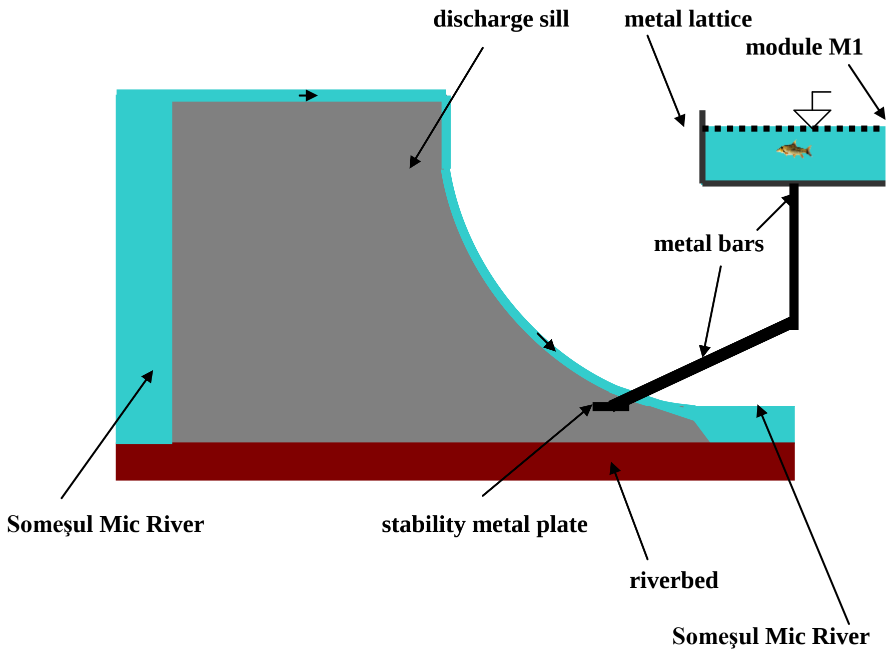

Figure 11 Fixing M1 and M2 modules to the discharge sill II – indicative scheme

CONCLUSIONS

This solution for fish migration upstream – downstream of the discharge sill near the town of Gherla on the Somesul Mic River only uses gravitational acceleration as drainage principle in the entire system. The proposed solution does not affect the structure of the bottom sill mentioned, it does not obstruct the water flow and does not require high costs of construction and maintenance. The system can be detached and used elsewhere where appropriate changing some dimensions of this system for fish migration above the discharge sill.

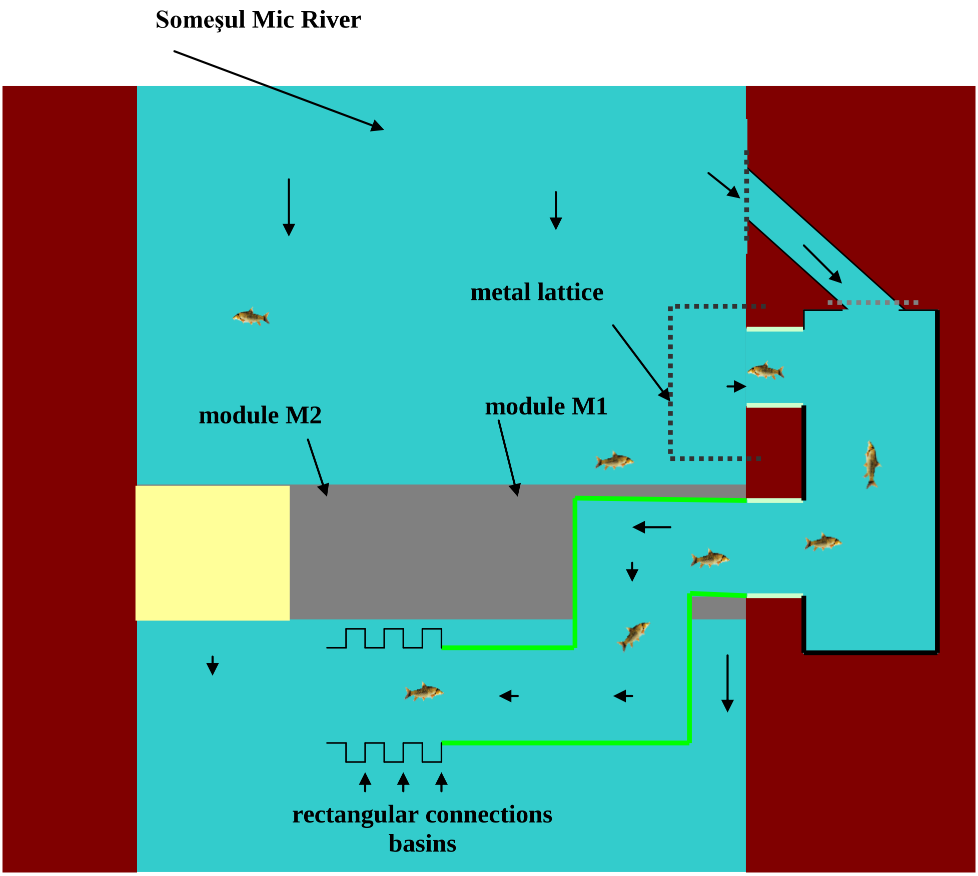

Figure 12 Positioning the three basins making the connection between the Someşul Mic River and the module M2 - II - indicative scheme

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