Restoring the river continuity of the Bresle River by returning it to its original bed in Sénarpont

The operation

Category	**Restoration**
Type of operation	**Returning a watercourse to its original bed**
Type of environment	**Lowland rivers**
Issues at stake (water, biodiversity, climate)	**River continuity, good status of habitats**

Start of operation	**November 2013**
End of operation	**May 2015**
Length of river affected by the works	**660 m**

The River in the restored sector

Name	**La Bresle**
Distance to source	**30 km**
Mean width *(bankfull width)*	**7 m** before works After the works, several channels of **different widths**
Mean gradient	**2,2 ‰**
Mean discharge	**1.07 m³/s**

The location

Country	**France**
River basin	**Seine-Normandie**
Region(s)	**Hauts-de-France**
Department(s)	**Somme**
Commune(s)	**Sénarpont**

Regulatory context	**Lists 1 and 2 L. 214-17**

European directive references

Water-body ref.:	**FRHRSAV07**
Natura 2000 site ref.:	**FR2200 363**
ROE code of the obstacle	**38669**

Aims of the project owner

- Restore the free passage of migratory fish.
- Restore the hydromorphological characteristics.
- Consolidate and revitalise the EU-listed alluvial wetlands.

Environment and pressures

The Bresle is a coastal river, 70 kilometres long, that flows into the English Channel at the town of Tréport. Agriculture is the primary economic activity in the river basin (748 km²). In spite of significant runoff from fields with no permanent cover, the physical-chemical quality of the water is generally good. The river is a category-1 river for fish and is mentioned in Lists 1 and 2 of Article L. 214-17 of the Environmental code.

Numerous migratory species, both diadromous (sea trout, Atlantic salmon, sea and river lampreys, European eels) and holobiotic (brown trout, brook lamprey), may be found in the Bresle. Given their ecological value, the valley and several tributaries constitute a Natura 2000 site.

Numerous weirs make passage difficult or impossible for fish, thus inhibiting the biological cycle of migratory species and blocking sediment transport as well. Over 230 obstacles have been listed throughout the river basin, many of them the historic relics of former grain mills and installations used to flood meadows, dating back in some cases to the 1100s.

As of the year 2000, the weir of the mill in Sénarpont [ROE 38669], 1.9 metres high with an impounded reach extending approximately 800 metres, represented the historic limit to colonisation of the Bresle by long-distance, migratory salmonids. The mill dates back to the Middle Ages and is made up of a leat, a bypass located in the middle of the leat, an outlet used to flood the underlying meadows and the main system component, a weir equipped with a large gate at the end of the leat.

Stéphane Forgeois, Onema

The Sénarpont weir, a total barrier for fish, in 2012 prior to the works.

When the mill and the leat were created, the Bresle was moved from its bed to a new channel, to become the leat. The structures of the Sénarpont mill blocked access to an 8 km section of river upstream, a reach without any major obstacles and conducive to the growth and reproduction of migratory species. The mill, abandoned since the 1970s, was in poor condition and the lack of upkeep had enabled the development of ecologically valuable environments, e.g. the wet woodlands of alder and ash between the two arms of the bypass channel.

Opportunities to act

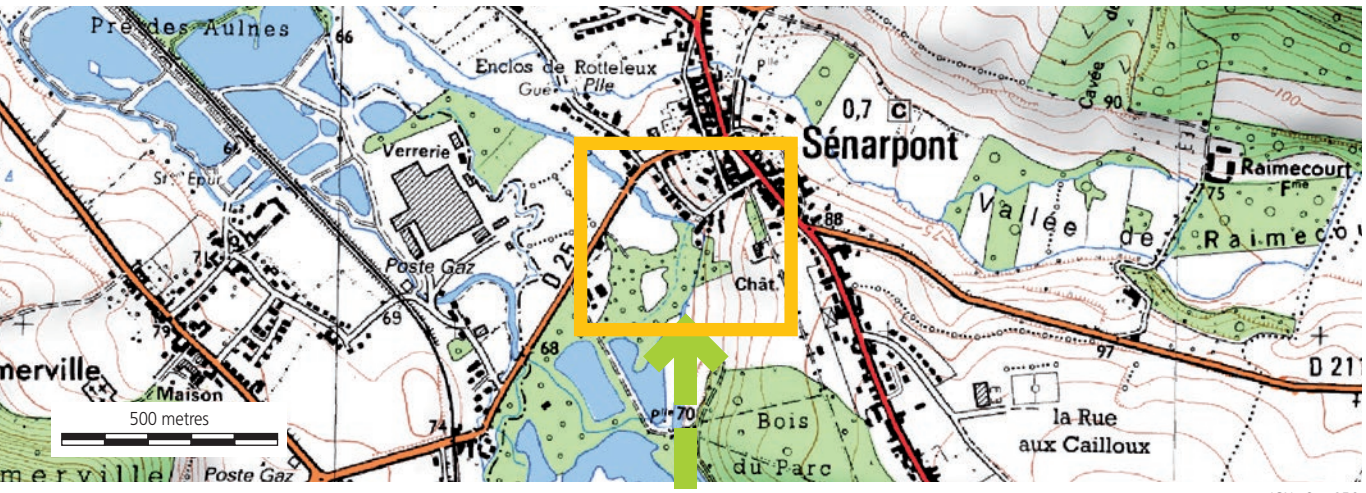
The Noriap agricultural co-op, the owner of the mill that it had not been used for 40 years, delegated its rights over the project to the Bresle public river-basin territorial agency (EPTB). Given the high ecological importance of the project and following several impact studies, in 2003 EPTB contacted the local land owners in view of returning the river back to its original bed. This first approach failed due in part, during the preliminary study, to communication efforts poorly suited to the local context and to the desire of the residents not to change the landscape. Numerous discussions subsequently took place to inform and to take into account the opinions of each person concerning the project. In 2011, one land owner still disagreed because he did not perceive the ecological value of the project and criticised a waste of public money. In 2013, the discussions with the land owners, in a partnership with the Downstream Seine territorial and maritime division of the Seine-Normandie water agency, continued. The project was modified toward more ambitious technical solutions, including two scenarios to restore river continuity, namely the creation of a fish pass or the return of the river to the original bed via the former bypass channels. Success was finally achieved in the discussions with a consensus on the project. The idea of a fish pass was abandoned because it offered insufficient ecological results given the issues at hand and the high cost. For an equivalent cost, the return of the river to its original bed would contribute more to improving habitats and avoid the maintenance costs of a fish pass.

Works and developments

The works, done at the end of 2013, consisted of creating multiple channels along the original bed, using some of the former bypass channels of the abandoned mill.

Some of the earthwork was done in the standard manner with machines designed for wetlands. The rest was done by the river itself which carved out its bed in the former bypass channels. This hydraulic earthwork was facilitated by the presence of gates to adjust discharges and to create a bankfull, morphogenetic discharge. Left to its own devices for over a month, but watched over by the earthworks company, the river redrew a perfectly natural bed. This method, thanks to the natural erosion, redistributed the coarse sediment of the banks and thus avoided the high cost of trucking in material. This method also avoided any compaction or damage to the alder and ash stand, which maintained its functions.

For the works, it was decided to adapt the project to the actual terrain rather than follow the theoretical course calculated during the preliminary phase.



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The result was a more natural river bed. The leat, was filled in with a soil and gravel mix brought in from outside the area to stabilise the terrain, in compliance with the commitment made by the project manager to the land owners.

Additional works, such as putting up fences and creating drinking points for livestock, was done in 2015 to maintain the farming activities while protecting water quality.

Regulatory approach

The works were authorised in accordance with the Water law.

Post-restoration management

A pasture for horses was created on the left bank.

Monitoring

Biological monitoring of this project is based on fish populations. The pre-works situation was assessed in 2013 on the basis of an electrofishing campaign in the leat. The assessment was carried out with redd countst on the project site in 2013 and 2014, and in 2015 with a count in the upstream 8 kilometres of river made accessible for fish by the works (the count was carried out in a partnership with the Onema salmonid centre). Post-works monitoring was done from 2013 to 2015. Two inventories were carried out in 2015 by the Seinormigr association, using the IAT (trout abundance index) protocol. The initial and post-works assessments did not implement identical methods, i.e. the first was a fish rescue in the former leat and the second implemented the IAT protocol. The results are nonetheless useful on the basis of individual density calculations.

Outcome of the project and outlook

The bypass of the Sénarpont hydraulic structure made possible to restore the continuity of the Bresle River a further eight kilometres upstream. The works also improved the functioning of the alder and ash wet woodland by enhancing the supply of water. The operation also restored 650 metres of river by reducing the impounded reach to 400 metres and reinjecting water into a number of side channels (250 metres). The connection between the riverbed and the side channels in the project sector created new expansion zones (in non-critical areas) for flooding. These lateral connections improve water quality through enhanced self-cleansing and the creation of greater habitat diversity, a positive factor for biodiversity.

The former impounded reach was replaced by a series of diversified flows in multiple channels in the valley bottom. Fine sediment was removed to reveal the coarse substrate that is now renewed naturally thanks to the restoration of the morphodynamic process.

Pierre-Marie Michel EPTB Bresle

The new channel in the talweg in 2014.

Pierre-Marie Michel EPTB Bresle

The diverse, intermediate zone in 2014, following the works.

Monitoring of fish revealed that prior to the works in 2013, trout density was 0.5 fish per 100 m². In July 2015, after the works, the measured density was 5.6 trout per 100 m². The trout population gained in numbers by a factor of 11 with a significant increase in the percentage of the juvenile population (30% of the total in 2013, 85% in 2015). The site has thus become highly favourable for spawners and the growth of juveniles.

At the end of 2013, just after the diversion of the river to its original bed, several sea trout were observed spawning in the restored channel. Five redds for migratory salmonids were observed on the site. One year later, a dozen redds were noted. During the inventory, bullheads and eels were also caught.

The strong point of this project is the restoration of the overall functioning of the river and of its side channels for a relatively small amount of money. The Bresle EPTB succeeded in defending its restoration objective and in negotiating over a long period to convince all the land owners and the town council.

Today, the results are positive. Local residents have easier access to the nature and take pleasure in observing a dynamic river with a diversified ecology.

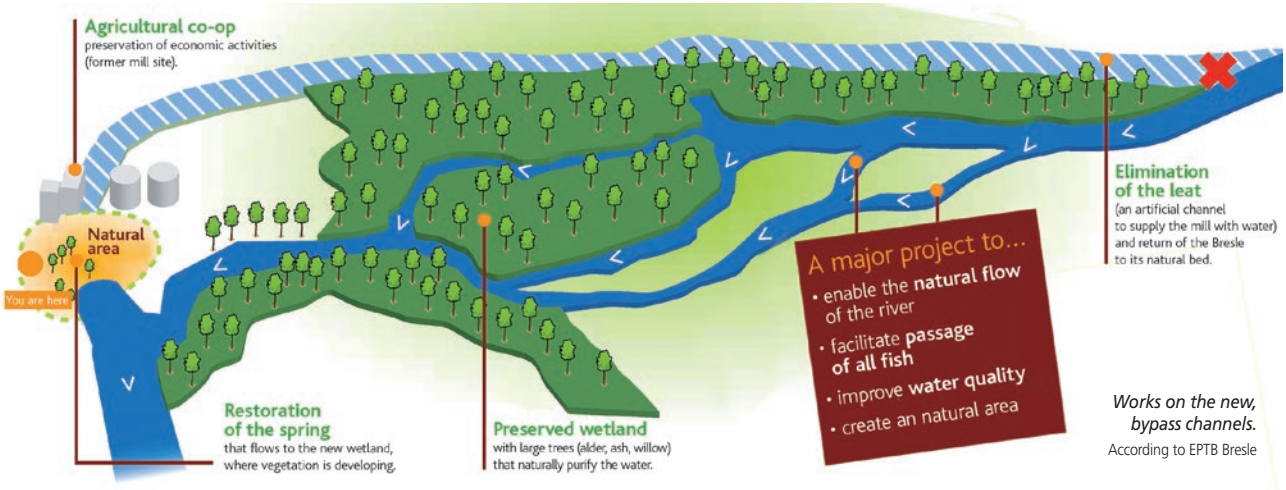
This project was all the more beneficial that a number of mill owners who were previously hesitant to work on their installations are now ready to launch operations to restore river continuity.

Costs

	In euros ex. VAT
Preliminary study	**38,880 €**
Purchase of land	*Not applicable*
Works and developments	**108,390 €**
Monitoring	*Costs assumed by various organisations*
Promotion *(printing of a brochure)*	**2,980 €**
Total cost of project	**150,250 €**

Financial partners and funding: *Preliminary study: AESN 80%, NORIAP 20%. Works: AESN 100%.*

Technical partners: *AESN, Onema, Somme departmental territorial and maritime agency.*



Works on the new, bypass channels.
According to EPTB Bresle

Promotion of the project

A large number of field trips have been organised by the Bresle Institution to present the project and its results to the owners of hydraulic installations, elected officials and other organisations. This particular approach has served as a showcase, notably to convince the owners of hydraulic installations to undertake work on their weirs. An informative sign is set up on-site to explain the project to visitors.

In 2015, the Bresle Institution received the "Environmental preservation" prize awarded by the Picardie regional council for an outstanding regional initiative for the environment. Numerous press articles on the project have been published and France 3 television also produced a sequence on this remarkable project.

• *Rétablissement de la continuité écologique et revitalisation de milieux humides d'intérêt communautaire à Sénarpont – Grand prix du génie écologique*. 4 pages.

• *Évaluation des effets des travaux de renaturation de la Bresle à Sénarpont sur la faune piscicole*. Institution de la Bresle. 2015, 2 pages.

• France 3 Normandie. Televised report (16 March 2014) on the restoration of continuity in the Bresle River. *http://france3-regions.francetvinfo.fr/haute-normandie/2014/03/16/senarpont-76-le-vieux-barrage-detruit-la-voie-est-libre-pour-les-poissons-433825.html*

Viewpoint

"It is interesting to note that the Bresle has returned to its natural bed. Today, visitors find a calm and relaxing environment. Walkers take pleasure in a charming site, offering a rich array of sights and sounds with the return of the natural sound of flowing water. The most striking change concerns the spot where the old waterfall existed. Work was recently done there to limit the strong vegetation growth."

Patrick Bèle, mayor of Sénarpont.

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