

→ Restoration of the surface flows of two temporary tributaries of the upstream Clauge

The operation

Category	Restoration
Type of operation	Remeandering
Type of environment	Headwaters
Issues at stake (water, biodiversity, climate)	Preservation or recovery of the water resource (quantity), good status of habitats and conservation of species
Start of operation	Autumn 2007
End of operation	2008
Length of river affected by the works	Approximately 3,000 m

River in the restored section

Name	The Clauge
Distance to source	6 km
Mean width	2 m
Mean gradient	10 %
Mean flow rate	Not determined

Aims of the project owner

- Slow down the flows and restore similar hydrological conditions to those that existed in the 1970s.
- Prevent regressive erosion.
- Raise the ground water table in order to improve forestry production.

Environment and pressures

The Sommière du Moulin rivulet and the Verne Fendue rivulet are temporary tributaries of the upstream Clauge. The River Clauge flows over 35 kilometres before joining the River Doubs. For 70% of its length, it crosses the Forêt de Chaux, which is the third-largest continuous broadleaf forest in France (22,000 hectares). The forest's hydrographic network includes 460 km of streams, only a tenth of which are permanently fed. The fish population consists of brown trout, chub and brook lamprey. The white-clawed crayfish is present in a small area (a few hundred metres).

In 1950, foresters who were inspired by agronomists to believe that the presence of water tables in soils was harmful to trees, started draining, straightening and

Location

Country	France
River basin	Rhône-Méditerranée (Mediterranean)
Region(s)	Franche-Comté
Département(s)	Jura
Commune(s)	Chissey-sur-Loue, Plumont, Fraisans



Regulatory context:	Morvan Regional Natural Park Biological reserve in which all forestry operations are prohibited
---------------------	--

References in relation to European Directives

Water body ref.	FRDR621
Natura 2000 site ref.	FR4301317

cleaning out around a hundred kilometres of rivers in the forest of Chaux, with a view to cleaning up these plots.

The rapid removal of high water levels then caused major regressive erosion. The streams cut deeper channels and the river habitats became homogenised, leading to reduced crayfish populations. Since the 1970s, the drying out of the river stream system has been observed and the limits at which the flows are permanent have moved several hundred metres



Pierre Durlet - PNR Morvan
The straight bed of a tributary of the Cloue in 2005, prior to the remeandering works.



IGN - Scan25®

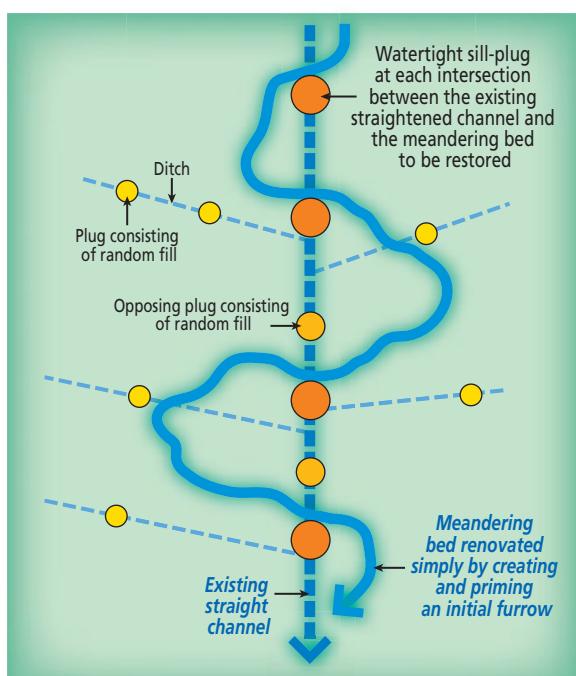
downstream. Finally, the forestry operators in this area have observed a tendency towards dieback, especially in oak trees.

■ Opportunities to act

Part of the Chaux forest (1,900 hectares) is included in the Natura 2000 site: "Vallons forestiers, rivières, ruisseaux, milieux humides et temporaires de la forêt de Chaux" (Forest valleys, rivers, streams, wet and temporary environments of the Chaux forest). This site was chosen for a project to reconstitute water reserves in the framework of the "LIFE" programme "Ruisseaux de têtes de basins et faune patrimoniale associée" (Headwaters and Associated Heritage Fauna).

■ Works and developments

The original meandering bed was restored by eliminating the straight bed via a series of watertight "plugs". At the same time, a narrow, shallow and sinuous furrow was dug in order to initiate the meandering course, which will only be completed when the original course and the connection with the downstream meander are no longer visible. This "groove" only acts as a guide in order to channel the flow away from the straight channel: therefore, it is essential for it to be smaller than the supposed dimensions of the meandering bed.



Graphe, d'après Lucot et al.

In the medium term, the straight bed segments and remaining ditches should be partially obliterated by the accumulation of organic matter (woody debris and leaves). In order to encourage this natural process, the removal of debris, jams and blockages from the stream beds, and even any maintenance of the riverside vegetation, are prohibited.

■ Regulatory approach

"Dossier d'autorisation" consent according to the French Water Act.

3.1.2.0 (A): Modification of the longitudinal and horizontal profiles

■ Post-restoration management

In order to take better account of streams in forestry, a "water-oriented" access and exploitation scheme has been implemented by the ONF (French Forestry Commission). This scheme is designed to develop access routes, including river crossings, and to adapt the land division system according to the streams in order to reduce the impact of forestry practice on these streams. This scheme allows the number of culvert passages to be reduced by at least 30% (collaboration with ONEMA [French National Agency for Water and Aquatic Environments] in the choice of culverts and fords).

■ Monitoring

Pre-works monitoring was carried out by the Université de Franche-Comté in 2005-2006 and an initial monitoring operation was carried out in 2008-2009. The level of the water table and aquatic invertebrates were studied. Piezometers were installed in three streams. Manual measurements (every 10 days) and automatic measurements (every 12 hours, Schlumberger WS probe) of the level of the water table were taken. With regard to invertebrates,



Corraine Forest - Onema

Example of a watertight plug used to eliminate the straight bed which will be filled in naturally and progressively (June 2009)

imagoes were captured from the riverside vegetation using a butterfly-type net.

■ Outcome of the project and outlook

The monitoring has revealed a modification of the hydric operation of the soils. The water table is shallower (-20 cm) and the variation in the

A tributary of the Clauge in January 2009 after the remeandering works.



Pierre Duflet - PNIR Morvan

Costs

Cost of studies	Unknown
Cost of acquisitions	Not applicable
Cost of operations and developments	€100,000 <i>i.e. per linear metre:</i> €33
Cost of promotion	Unknown
Total cost of the actions	€100,000

Financial partners and funding:

"LIFE" (European Union, French Ministry responsible for the environment), Regional Council of Burgundy, Water Agency for the Rhône, Mediterranean and Corsica regions, and the Seine-Normandy Water Agency.

Technical partners of the project:

Université de Franche Comté, Natural Regional Park of the Morvan, ONEMA (French National Agency for Water and Aquatic Environments) – its inter-regional delegation for Burgundy-Franche Comté and departmental unit.

groundwater level is reduced. The high water level has risen, while runoff is slower and therefore more favourable to aquatic fauna. The soils have an increased water storage capacity. At present, the remeandering has allowed water to remain in the soils for an additional fifteen days in springtime (and this figure should increase over time). These increases are helping to combat dieback in oaks.

A greater number of invertebrate taxons have been recorded after the works. A hitherto unseen species has been captured: the checkered caddisfly (included on the endangered list of invertebrates threatened with extinction), which is a flagship species of wetlands.

Ideally, in order to restore the hydrological processes of both tributaries completely, the straight channels and all ditches should have been completely filled in. However, the magnitude of the works required for the implementation of this "exhaustive" approach could have had a profound impact on the tree cover, with a risk of soil degradation. The cost would also have been prohibitive, especially in view of the amounts of materials to be transported.

Over time, the plugs will become increasingly watertight and straight sections of the river will be naturally filled in. The project requires minimal intervention and the foresters, who are used to adopting a long-term approach, will allow the river as much time as it needs to fill in the straight sections (possibly 50 years).

This operation also contributes to preventing the potential effects of global warming by taking immediate action in order to make soils cooler.

Promotion of the project

This experiment has been promoted by various articles and reports in the forestry sector.

Visits to the site were organised for the handover of the works for the LIFE programme. Information boards have also been erected.



Project owner	Office national des forêts
Contacts	<p>Vincent Pietra ou Vincent Augé Office national des forêts vincent.pietra@onf.fr vincent.auge@onf.fr</p> <p>Pierre Durlet Parc naturel régional du Morvan pierre.durlet@parcdumorvan.org</p>



Lucot E., Degiorgi F., Augé V., Pereira V., Badot P-M., Durlet P. (2008). «Les effets du reméandrement de ruisseaux temporaires en forêt de chaux (Jura, France) sur le fonctionnement hydrique des sols rive-ravins : premiers résultats», Forêt wallonne 97: 29 - 38.

This report can be downloaded from the following address: http://www.liferuisseaux.org/realisations_etudes/Chaux/remeandrement_foret_chaux.pdf

See the monitoring reports on the Life website:

<http://www.liferuisseaux.org/vallons.htm>

http://www.liferuisseaux.org/Rapportsactivites/Livret_Eléments_Techniques.pdf

