

# Maka hall at Yvoir : construction of a pool pass

### **Existing barrier**

Masonry-made spillway + winnowing

- Difference in heights: 1.90 m.
- ➢Issues: gateway of the Bocq Basin; confluence with the Meuse River
- > Landmark species: trout, grayling, barbel
- Property: municipal; private concession for the hydro power plant
- Average flow of the Bocq: 2.31 m<sup>3</sup>/s



### **Major constraints**

Construction of a hydro power plant (rotating auger)
Confined urban site; very difficult access; security issues

### **Technical arrangements**

- 8 falls 24-cm height (7 pools)
- Dimension of the notches: 0.30m wide ; 0.8m minimum water height
- submerged orifices: 0.2 X 0.2 m
- Reserved flow = 370 l/sec (= nominal pap flow)
- Reinforced concrete
- Coarse bottom substrate (rocks drowned in concrete)
- water level upstream almost constant (automatic valve)
- Control trap



### **Cost**: 214,285 €

Commissioning: October 2011



















# Aminthe Foundry at Yvoir : cascaded dams pass

### Obstacle

Masonry-made spillway
➢ Difference in heights: 1.50 meters
➢ Use: feeding a former landscaping (and sanitary) section of river
➢ side-sifting, with manual activation at times of flooding

Property: private

Iandmark species: trout, grayling, barbel

### **Major constraint**

Difficult access

# Technical arrangement: cascaded dams of concreted rocks

7 falls, 20-22 cm height

2 notches (5 thresholds upstream) or 1 notch (2 thresholds downstream) per dam

 Minimum water heights in notches: from 0.30 m (upstream) to 0,50 m (downstream)

Basic flow in arrangement: 440 litres/sec. (before spillway spilling))

Overall cost: 78,034€ End of works: July, 2012





### Specific difficulty:

Notch dimensions in side spillway had to be remade (flow coefficient Kd= 1.3 instead of classic values of Kd= 1.9 to 2.1)



# Dapsens Park : by-pass channel (River Bocq)

### **Obstacle**: masonry-made spillway

- Difference in heights: 1.50 meters
- Use: landscaping park
- Property: private
- Side-sifting, with manual activation at times of flooding

➤Landmark species: trout, grayling, barbel

### Technical arrangement: by-passing channel

- Length: 66 metres
- Flows down onto an existing side channel
- Average slope: 2.2%
- Basic flow: 250 litres/sec
- Alternating pools and riffles
- Rock-filled, earth-sealed banks and bed
- Small weir in the side channel to improve attractivity for fish into the by-pass channel

### **Major constraints**

Need to build footbridge, access Violent floods

**Cost**: 75,004€ (footbridge not included) Commissioning: June 2011







# Spontin village : removal of a weir (masonry-made spillway)



### **Obstacle: masonry-made spillway**

- Difference in heights: 1.20 m.
- No defined use
- Flood potentially damaging
- Landmark species: trout, graylings

### **Major constraints**

• Retaining walls protecting a main drinking water pipeline

### **Opportunities**

• Land to be bought with pond

**Cost**: 79,170 € (land acquisition excluded) End of works: December 2010



### **Technical arrangement:**

- Demolition of the masonry weir
- Stabilisation of the retaining wall
- Fish shelters through holes into the wall
- Building 2 bottom sills to reduce headward erosion
- Stabilising of banks along a 200-m distance (riprap groynes, banking and plantations)





# River Bocq at Spontin (VIVAQUA) : Rehabilitation of a 600 meters concrete/masonry channel through step /pool scheme

### Context

➢ On a 600-m long area, the Bocq was straightened and channelized so as to avoid contamination of drinkable water collection.

> This resulted in a loss of habitat, as well as a breaking in the longitudinal continuity (insurmountable barrier) due to high velocity and shallow water.

Landmark species: trout, graylings

### Constraint

Flood risks of the drinking water well cannot be increased
 Objective

➤ to restore ecological continuity

### **Technical arrangements:**

- step/pool scheme based on a cascaded construction including 23 boulder bars
- +35 cm rise of waterline
- Blocks fixed on top of the concrete apron or retained with steel corners
- Rock-filled berms of different sizes
- 200 T of pea gravels, for creating spawning ground
- 56 stone made fish shelter
- 140-m long and 50-cm high dike on the left side together with and excavation of a dry cut on the right side

**Cost**: 317,000 € End of works: September 2012



### **Major difficulties**

• Need to retain or fix boulder and block in concrete aprons





# Gemenne : By-pass channel and placing trees for habitat diversity

### The problem

Old sluice gates for irrigation to be maintained

- Massive silting-up upstream
- Height of fall before works: 1.65 m
- > Average flow: 1.57m<sup>3</sup>/sec
- ➤ Low flow (P95): 0. 610 m³/sec
- Degraded riverbed along 400 m upstream
- Landmark species: trout, grayling



### **By-pass channel**

- Cleaning 30 metres upstream the winnowing, and lowering headwater level (-80 cm)
- Height of fall after works: 0.85 m
- Arranging the by-pass channel in a flooding arm
- Average slope = 2.1%
- Basic flow= 350 litres/sec (low water)
- Quiet areas (pools)
- Banks protection by rock-filling or rock-filling with meshed-coco + plantations

Total cost : 80,385 € End of works: November 2012

### Arrangements of habitats along 400 m upstream dam

- Earth moving for low-level berms, for helophytes
- Installing fish shelters and deflectors made of trunks and
- stumps in the waterbed (60 trunks, 20 stumps)
- Digging of 2 bays connected to the mainstream





# Emptinale : Re-meandering and culvert bed improvement

### **Problem**

The Bocg river was straightened and the stream partly culverted in the aftermath of road RN921 construction

 $\succ$  Loss of habitat

Impassable culvert at low flow (insufficient) water depth)

### Low stream power (=20W/m<sup>2</sup>)

### **Objective**

**Cost**: 72,010 €

Fast recovery of lost habitats

### **Re-meandering**

Creating 2 highly sinuous meanders along a 100metre straight

- High differentiation of facies, incl. riffles
- Installation of spawning grounds and fish shelters
- Minor or inexistent bank protection (gentle) slopes)

### **Culvert bed improvement**

- Sludge cleaning
- Rock-filling for a shorter section
- Scattering of pebbles and rocks on concrete bed





# Petit Bocq at Natoye : Re-meandering and new rock-filled ramp

### Problem

 An old, unsurmountable dam with a 3.30 metre level difference
 A waterway not flowing in its thalweg
 Gully erosion caused by flooding
 Landmark species: trout

### **Objectives**

- To put the waterway in the talweg of the floodplain
- To remove the obstacle
- To allow for certain fluvial dynamics

### **Flows**

- DC11= 0.082m<sup>3</sup>/s
- DC1= 0.290m<sup>3</sup>/s
- Flooding 10 years = 4.9m<sup>3</sup>/s

### Constraint

- Unstable land (wetland)
- Waste water drain (underground)





### Works

- building a 1.8 meter high cascaded construction including 9 rockfill thresholds with 20-cm wide notches
- re-meandering channel along 260 metres, with a 0.95% slope
- pool-riffle sequence re-installed
- 75 tons of gravel for spawning ground
- 12 trunks for fish hidings

### **Major difficulties**

- Swampy land
- Adjustments in rock-filled thresholds

**Cost**: € 136000€ End of works: September 2013





### Problem

During the 60's, the Eau Blanche river was straightened and over-widened and its banks were covered with riprap

along 2.5km

### Objective

- To restore a good diversity of water habitats
- To increase the fluvial dynamics

WALPHY

### Constraint

• Flooding risks medium to high

### **Description of works:**

- Removal of a 60-cm-high level obstacle upstream (old mobile hatch constantly opened)
- Narrowing the low-flow channel, creating new berms and micro-meanders with wooden or earth/rock artworks
- Removal of specified rock-filled protections of banks
- Creating small islands
- Creating fish hidings with trunks and stumps
- Restoration of spawning areas
- Planting of helophytes, willows and alders





**Cost**: 193,358 € End of works: May 2011



# Eau Blanche at Nismes : creating a sinuous low-flow channel in an over-widened river along 2.1km

### Problem

➢ In the late 60's, the Eau Blanche river was straightened, deepened and rock-filled.

### Opportunity

- Flooding risk is low (middle part only)
- Furrow slice on top of bank available in some spots

### Ambition

- To create a meandering channel on the minor bed (secondary meandering)
- To allow for a limited fluvial dynamics (banks erosion)
- To maintain & develop interesting habitats

### **Description of works:**

- Creating 9 meanders in straight sectors (digging and filling work)
- Removal of rock-filled banks protections in specified spots, and removal of a concrete crossing ford
- multi-stage, gentle slope widening
- creating shoals and islands
- Laying of trunks and stumps into the bed as habitat or deflectors
- Paving stones as fish shelter
- Laying of 64 T of pea gravels scattered among 11 areas of rapid flow, for creating spawning ground
- Digging of backwaters
- Planting of helophytes, willows and alders





Earthmoving for meanders: typical profile

**Cost**: 80,190€ End of works: September 2011



# Eau Blanche at Boussu-en-Fagne : reconnecting remnant

### meander

### Problem

> During the 60's, the Eau Blanche was straightened, deepened and the banks covered with riprap along a 10-km portion

It resulted in an embankment at Boussu (riverbed does not flow at lower point of floodplain)

**Opportunity:** neighbouring land made available by owner

### Ambition

- To recover old route and raised bed along 160 meters
- To maximise the habitat diversity at start
- To able river dynamics

### Constraint

Need to keep the same low level of flooding



•Over-dimensions of cross sections (two-stage channel) •Carrying of a dry by-pass channel

### Works:

- Embankment of the straightened bed, keeping a flood spillway
- creating backwater in old bed
- Levelling (1,300 m<sup>3</sup> to be removed) at former riverbed straight (clearance of gravels and residual scoria; bed gradient=0.1%)
  Removal of downstream small weirs (total h = 40cm)
- Building bottom sill at the end of the meander so as to reduce headward erosion (maximum meander slope = 0.28%) and keeping riffles
- Laying of trunks and stumps on banks
- Scattering of rock-filling blocks
- Planting of helophytes, willows and alders





**Cost**: 77555€ End of works: November 2011





# Boussu-en-Fagne : **Restoring the meandering course** of "Grand Morby"

### **Starting point**

➢ In the late 60's, the Grand Morby stream was straightened and moved.

At Aublain, 4 km upstream Boussu, the stream was connected by derivation to the Eau Blanche, thus increasing artificially its natural discharge
 Several trout spawns observed; lamprey also present
 Natura 2000 classified area.

➢ average slope: 0.12%

### **Objectives**

- To bring the Morby back to its original bed, in the floodplain's thalweg along a still visible sinuous route including oxbows (total length=1 km)
- To keep an minimum flow (15 l/sec) into the rectified bed

### **Flows**

• Basic flow Morby Project: 70 l/s

### Opportunity

• The route of the former bed is still under public property (no acquisition)



### **Description of works:**

- Earth removal along 480 metres on the former, covered bed in the grassland
- Earth removal and cleaning in specific spots of former, nonfilled bed
- Several profiling works, with narrow, deep (min. 30 cm) channels of low water,
- Laying of pebbles and rocks for spawning areas
- Laying of trunks and branches for fish shelters
- Construction of 3 agricultural bridges, troughs, nose pumps, fences
- Planting of willows and helophytes

**Cost**: 89,400 € End of works: December 2012