

# Best practices for buffer zone implementation at watershed scale

*Jean-Joël Gril  
Cemagref  
Lyon, France*

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on the sustainable use of pesticides  
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# Water contamination by pesticides : the two functions of buffer zones

## Runoff interception



## Drift interception



# What is a buffer zone for drift control ?

- Any **untreated area** keeping the treated area **remote** from the surface water
- → Relatively “simple “: location, sizing ...
- → For surface water protection only
- → *A regulatory frame* (*authorization – non treated zone*)
- *A limit : drift disposal on impervious surface (roads, ...)*  
*= possibility of runoff transfer*

# What is a buffer zone for runoff control ?

- **Non treated, grassed or wooded perennial zone, between cultivated fields, in convenient position to intercept runoff, anywhere in a watershed**
  - *Firstly, for surface water protection,*
  - *but also groundwater (sinkholes)*



# Some sorts of buffers



« classical » grass strip



Meadow in a dell



Wild land (*after wood clearing*)



Poplar planting



Riparian forest



# Efficacy of buffer zones *for pesticide control in runoff*

- International review:
  - Ca. 0 to 100 % !
- French experiments (natural rain conditions)
  - Often > 90 %
  - Nearly always > 50 %
  - *Infiltration is the main process of this control*  
(> *sedimentation and surface adsorption*)



# Consequently: 2 weak points and 1 interrogation

- **Weak points** : the limits of infiltration
  - Infiltration rate
  - Runoff concentration
- **Interrogation**
  - Fate of infiltrated substances?



# Infiltration limits of a buffer

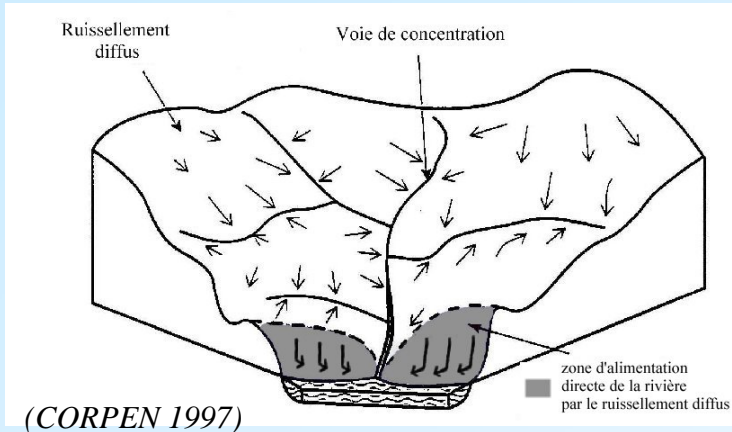


**Hydromorphy / waterlogging**

**Soil compaction**



# Runoff concentration



Runoff concentration

(← natural

or man made →) ...



(Photo AREAS)

... limits buffer capacity for interception:

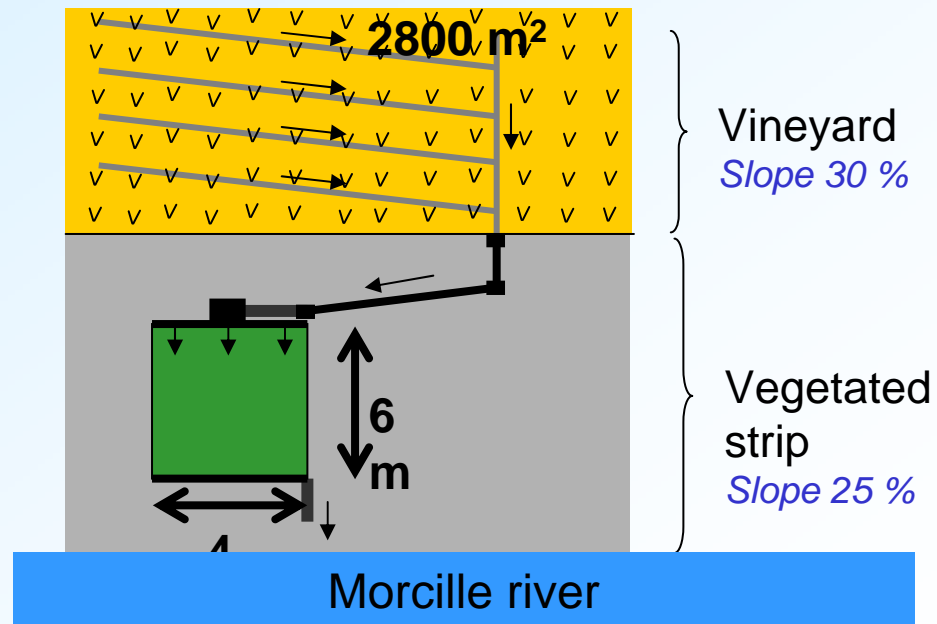
- by overpassing of infiltration capacity
- by submersion

An extreme case : ditches and tile drainage



# Fate of infiltrated pesticides in a buffer

*A field lysimeter study in Beaujolais Vineyard  
50 cm deep, very permeable sandy soil, high runoff rate  
and high concentration rate : a worse case!*



**42 to 66 %** of applied pesticides stay located in surface soil,  
depending on adsorption capacity ( $K_{oc}$ )

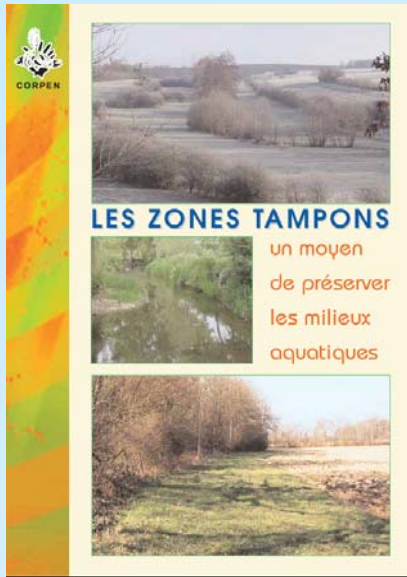


# Practical questions concerning runoff interception

- **Location**
- **Sizing**
- **Vegetation**
- *Complementary facilities*
- *Maintenance*

*More detailed in a recent CORPEN review about buffer zones:*

**“Environmental functions of buffer zones – 1st edition: scientific and technical basis of their water protection functions”**



**Presentation booklet**  
(20 p.)

*Runoff: N, P and pesticides*  
*Drift control*  
*Riparian protection of aquatic life*

***A translation in English is planned***

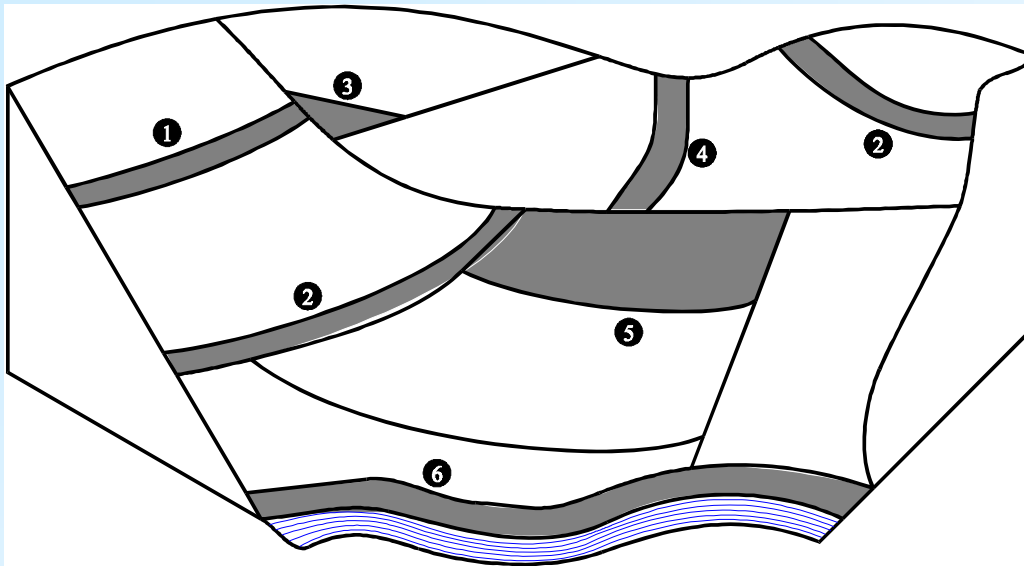


**Book**  
*Main text (75 p.)*  
*Annexes (100 p.)*

<http://www.ecologie.gouv.fr/-Les-productions-du-Corpen>



# Possible locations



- ① strip in the field
- ② strip on field edge
- ③ field corner
- ④ grassed waterway
- ⑤ meadow (or wood) across a talweg
- ⑥ strip along a water course (or lake)

*And also along roads, pathes, around swallets ...*

# Some non-riparian buffers



**Edge of field**



**Meadow across a talweg**



**Hedges**



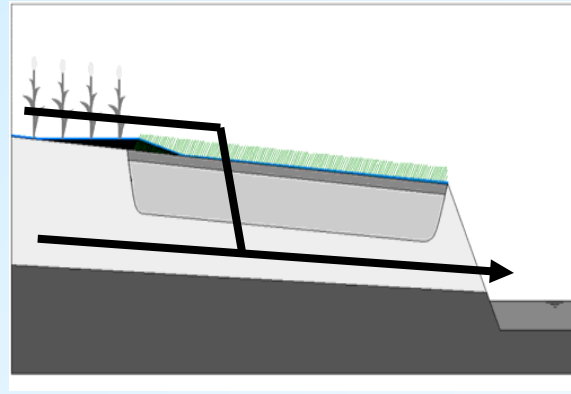
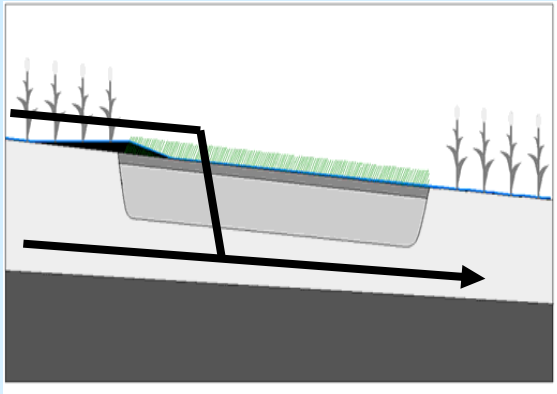
**Between field and road**



**In a downslope corner**

# Riparian vs. Slope buffers

Riparian buffer are potentially  
less efficient:



- *Often more humid*
- *More flow concentration*
- *← Proximity subsurface transfer*

However, Riparian buffers are of prior interest:

*Drift control*

*Proximate protection*

*Sociological acceptance (and policies)*

1°) **Verify presence and efficacy of riparian buffer**

2°) **complete them by slope buffers, if necessary**

**→ Necessity for a local diagnosis**

# Sizing

## ■ USA current proposal (NRCS) - 2000

A standard width = 15 m

## ■ France current proposal (CORPEN) - 1997

**Diffuse** or  
slightly concentrated flow

Slope < 100 m → width = 10 m

Slope > 100 m → width = 20 m

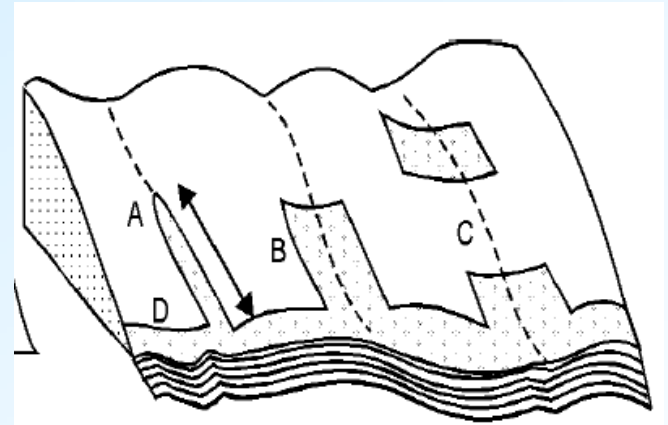
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## **Highly concentrated flow**

A riparian buffer + buffer

« cascades » in talwegs

(meadows, woods, ... : **usual sizes**)



Similar ... and both by guesswork: **need for simple and robust models!**

- integrating **soil humidity influence**, and **not only surface processes**
- based on **scenarios**, needing few and simple local parameters



# Vegetation

Any species (grass or wood) **favoring a good infiltration** in the buffer

- ➔ No annual crops
- ➔ A possibility : non (or very few) treated perennial productions:
  - Woods: timber, energy, finewood ...
  - Miscanthus, bamboo ...

Interest of **association**:

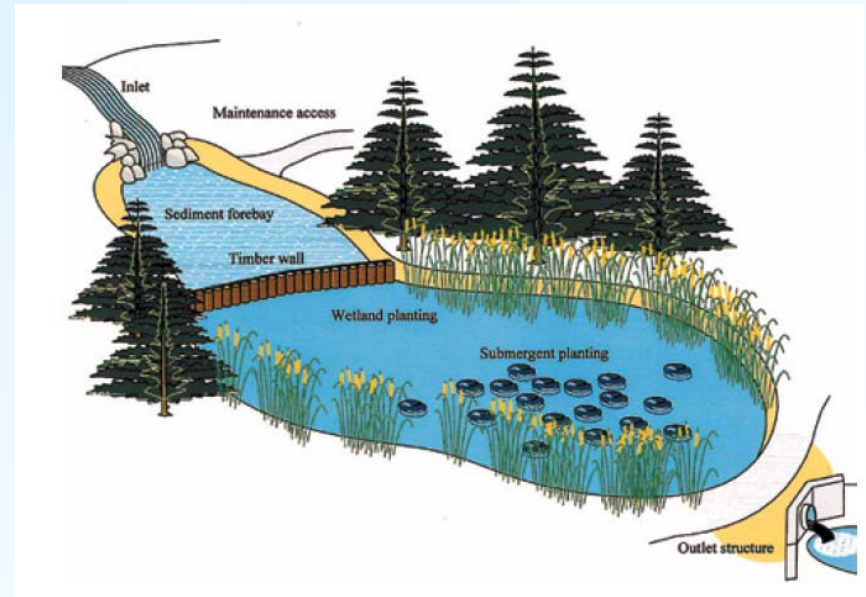
**up** = grass (sedimentation, erosion control)

**down** = wood (infiltration)



# An alternative to “dry” buffer zones: restored or constructed wetlands

*To complete or replace buffer in humid places,  
To intercept ditch or tiled drain flow*



Still need for operationnal knowledge in Europe conditions



# **Consequence for buffer implementation in a watershed**

**Adaptation to local situations  
or**

**Systematic application of a standard?**



# Advantage and disadvantage of adaptation to local conditions

- **Advantage**
  - Takes into account watershed characteristics and agricultural practices
  - a guarantee to optimize efficacy
- **Disadvantage**
  - Cost and not immediate response (local diagnosis needed)

# Advantage and disadvantage of a standard application

- **Advantage**

- Obvious simplicity!

- **Disadvantage**

- Risk for poor efficacy in certain situations and/or during certain periods of the year

- **Practically, restricted to riparian buffers**

# A proposal to conclude

- **Systematic and obligatory riparian buffers:**  
drift and runoff control (total or partial)  
*= standard width (i.e. 5 or 10 m)*
  - To **complete**, as necessary according to a **local diagnosis** with two possibilities:
    - Widening of this riparian buffer
    - Addition of **slope buffers** (down fields and concentration ways)
- Urgent need for operational diagnosis tools**  
*(work currently running in Cemagref, France)*