



3-Dimensional Buffer strips

Buffers designed to deliver more

Research commissioned by the Environment Agency and Forestry Commission

Researched by James Hutton Institute and Forest Research

The traditional grass buffer

Pro's

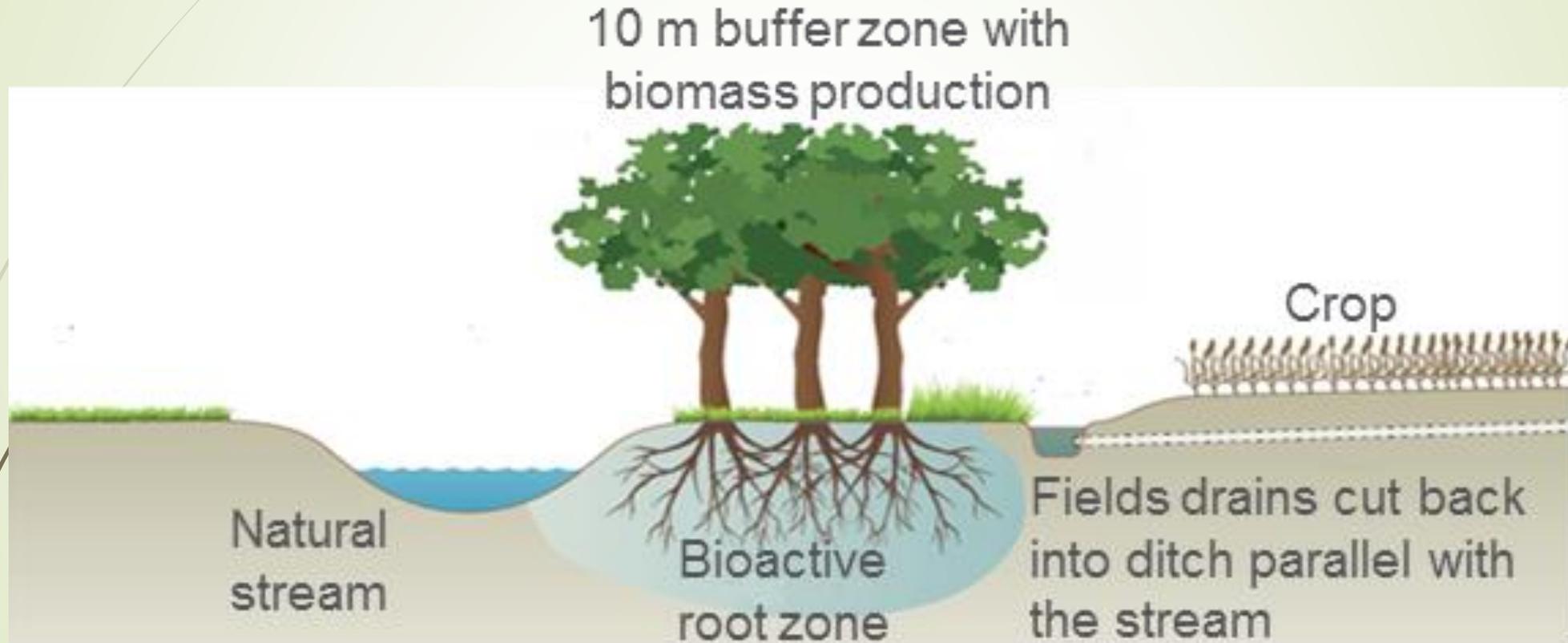
- Widely adopted and understood by farmers
- 3,000 ha of buffer in agri-environment
- Easy and cheap to establish
- Sets agriculture away from water
- Filters coarser elements of run-off



Cons

- Not always effective: large variation in efficacy
- Limited value to the wider environment
- Single mode of action
- Often too narrow to work well
- Phosphate soon builds up to saturation
- Easily over whelmed in heavy rain

Potential 3-dimensional (3-D) buffer



It is important to protect a pollutant source, so that the buffer is not overwhelmed. This allows the 3D buffer to be a “treatment- train” and not a panacea for field protection.

Why change?

What buffers do

Grass buffers are a basic measure, good as part of a treatment train for diffuse pollution

A good 6m grass buffer might control:

- **50% of nutrient load**
- **-83 to +85% Phosphorus**
- **-25 to +95% Nitrate**
- **30% Sediment**

BUT efficacy is very dependent on slope and soil type

What they could do better

3-D buffers are a treatment train in their own right and will get the most from land used for buffers. They will

- **Reliably capture more pollutants**
- **Prevent nutrient build up.**
- **More effectively slow the flow across the strip**

They are much more effective than grass buffers in pollution hotspots

dimensional buffer examples

Basic grass buffer



Wooded buffer



Raised buffer edge



Integrated buffer



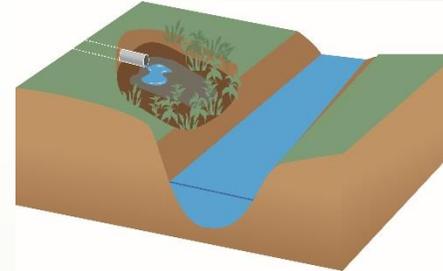
Magic margins



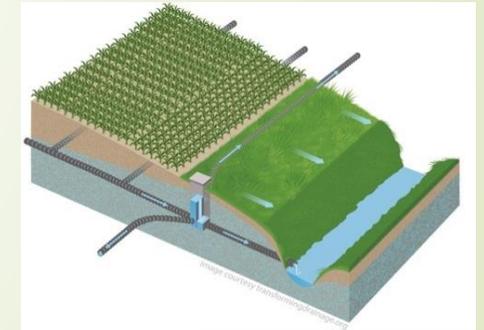
Sediment traps & Swales



Cut back field drainage

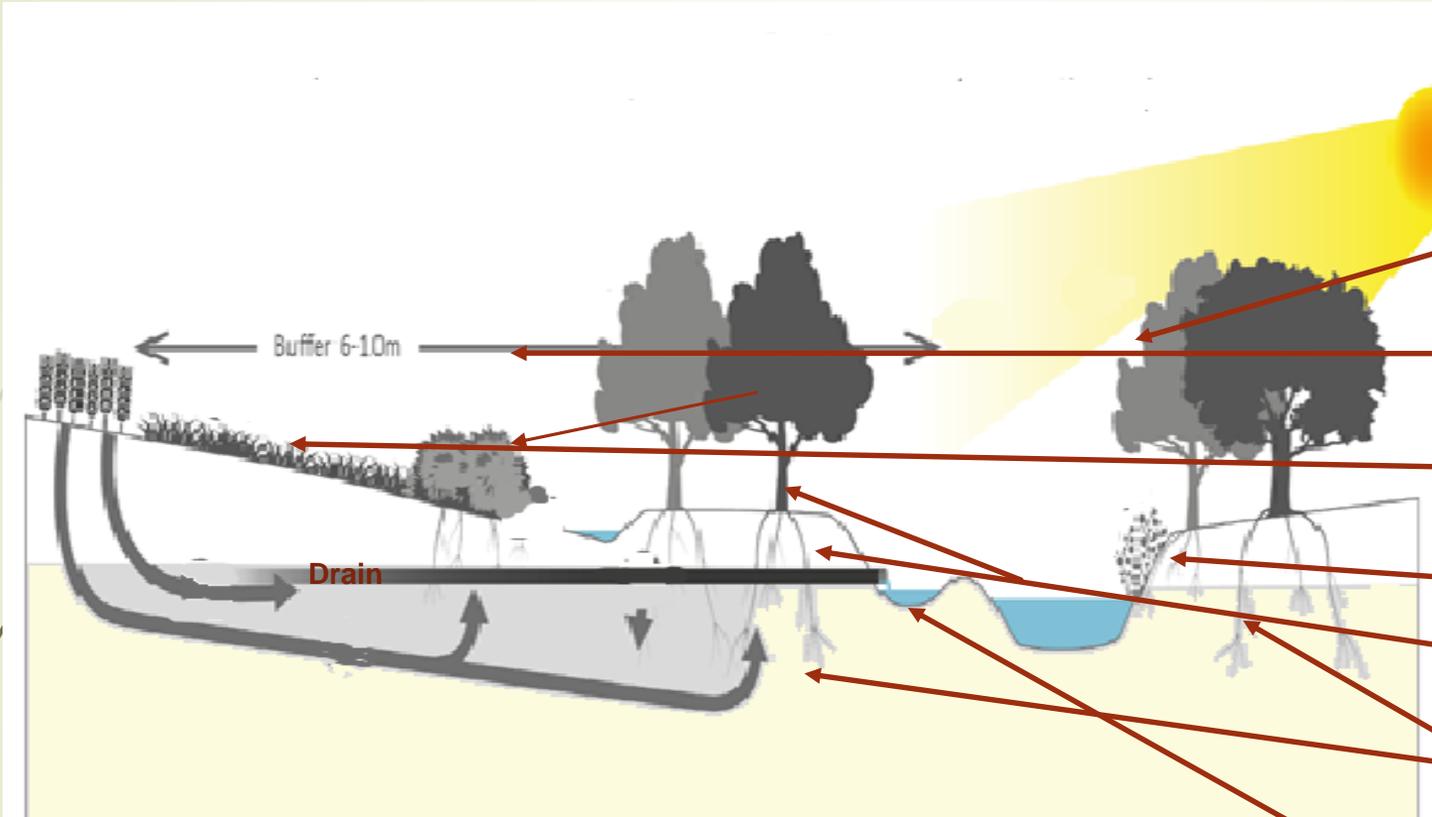


Controlled irrigated drainage



See main report for a discussion of the benefits and disadvantages of each type

Benefits of 3-D buffers

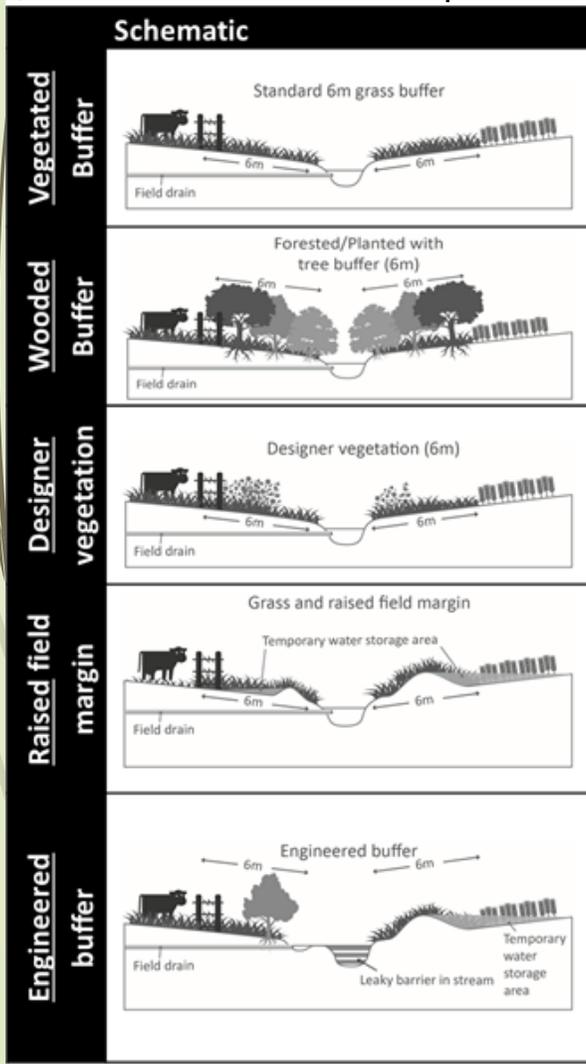


Adaptable to local needs, they work on, above and below the ground to:

- ☐ increase shading to keep water cool
- ☐ Intercept spray drift of agro-chemicals
- ☐ Intercept pollution in surface water
- ☐ Roots stabilise banks
- ☐ Slow flows and encourage water to infiltrate
- ☐ Incorporate nutrients in vegetation and enhance soil organic matter
- ☐ Intercept pollutants from field drainage to provide biologically rich wet areas

How the designs work

The report



Grass buffers: moderately good for nutrient and sediment in light run-off. Easily overwhelmed, little sub surface activity.

Wooded buffer: better uptake of nutrients and reduced pesticide drift. Additional benefits of shading, intercepted air pollution and carbon uptake.

Herbaceous vegetation: enhancement with deeper rooting species. Already an agri – environment option, gives additional biodiversity benefits

Raised field margin: improves storage of run-off where grass buffer might be over whelmed. Gives varied habitat including wet area to enhance biodiversity

Engineered buffer: bespoke design can maximise storage for extreme run off situations. May include interception of field drains.

Understanding flow pathways will help determine the type of buffer to use



Photo: Courtesy Evenlode project

Each * represents 20% load reduction at **Low**, **Medium**, **High** confidence

	Soil Retention	P Capture	N Capture	Pesticide	FIO retention	Comments
Vegetated buffer	** High	* High	* High	* High	*** High	<ul style="list-style-type: none"> • Considerable evidence. • Good in low risk situations • Easily overwhelmed in wet conditions
Wooded buffer	*** Medium	*** Medium	*** High	***** Medium	*** Medium	<ul style="list-style-type: none"> • Good evidence to suggest general effectiveness • Provides many benefits in addition to water
Designer vegetated buffer	** Medium	* Medium	* Medium	* Medium	*** High	<ul style="list-style-type: none"> • Will act in a similar way to grass vegetated buffers
Raised buffer	*** Low	*** Low	** Low	** Low	*** Low	<ul style="list-style-type: none"> • Little research. • An easy way to improve efficacy • Good for sediment, P & FIO
Engineered buffer	***** Low	***** Low	***** Low	*** Low	*** Low	<ul style="list-style-type: none"> • Limited research • Considerable potential • Use in high risk locations • Features already widely adopted

Effectiveness for flood risk

Each * represents 20% load reduction with **Low**, **Medium** or **High** confidence

	Flood water retention	Shading	Habitat bio-diversity	Geomorphology	Carbon Retention	Comments
Vegetated buffer	* Medium	* High	** High	* High	* High	Increasing roughness with tussocky grassland could improve habitat for voles and associated hunting birds.
Wooded buffer	**** Medium	***** High	***** High	***** High	**** High	Scores highly for most functions over a vegetated buffer . Desired 50% Shading is tree height dependent.
Designer vegetated buffer	* Medium	**** High	***** Medium	* High	* Medium	Opportunity to enhance biodiversity, but this may be at the cost of other services.
Raised buffer	*** Medium	* High	** Medium	*** Medium	* Medium	There is a potential to create a complex habitat mosaic from wetter and drier ground.
Engineered buffer	**** Low	**** Low	***** Low	***** Low	** Low	Various designs; may include bunding for temporary water retention. Good potential for complex habitats.

3D buffers and flood management

- Working with natural processes such as swales and magic margins
- Slows the flow of run-off
- Riparian trees will increase hydraulic roughness & increase infiltration
- In future can be material for leaky structures

One case study showed a 30m wooded buffer with woody debris structures reduced peak flows by 10%



Buffer potential in England

There are 500,000 km of watercourse in rural England. A six metre 3-D buffer strip on just streams and rivers would provide over 200,000 hectares of valuable habitat corridor.

- ▶ Grass buffers can provide an effective buffer between cultivated land and water courses but only in low risk locations
- ▶ 3D wooded buffers improve most functions (scored highest overall) and have a substantial supporting body of evidence
- ▶ 3D buffers can significantly reduce soil and nutrient and pesticide losses from adjacent land to water courses in moderate to high risk locations.
- ▶ They will provide significant land for trees, new habitat and play a valuable role in flood management
- ▶ This underexploited measure, if taken up more widely, will mitigate losses from agriculture and improve our natural capital

Download the full report [here](#)