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CASE STUDY
02

3D Wetland Buffer

Intercepts and treats subsurface drainage water through sedimentation, filtration, and nutrient removal before reaching nearby watercourses.

Overview

This enhanced wetland intercepts subsurface drainage, allowing sediments to settle and nutrients to be filtered and biologically processed in a vegetated zone. A raised bund provides flood storage, with outflow regulated by a V-notch weir.

How They Work

1. Subsurface Pipe Excavated and Cut

A section of the subsurface drain is removed, and water is routed into a wetland treatment zone.

2. Sediment Trap Zone

Flow velocity is reduced using control structures, allowing coarse sediments to settle out.

3. Wetland

Vegetation provides carbon for denitrification and helps remove phosphorus through uptake and settling.

4. Raised Soil Bund

Creates additional storage and temporary ponding during flood events before returning to normal. Water levels are regulated by the V-notch weir.

5. Treated Water Joins Nearby Watercourse

Reduced nutrient and sediment loss improves water quality and helps protect aquatic habitat and channel stability.

Primary Function

Reduction of phosphorus and nitrate pollution from subsurface agricultural drainage before reaching a nearby watercourse.

Location Considerations

- > Best suited to field margins with shallow depressions where subsurface drains join small watercourses.
- > Sites with high pollution loads (e.g. yard runoff) should avoid placing wetlands near watercourses due to risk of plume migration - these require safe setback distances upslope.

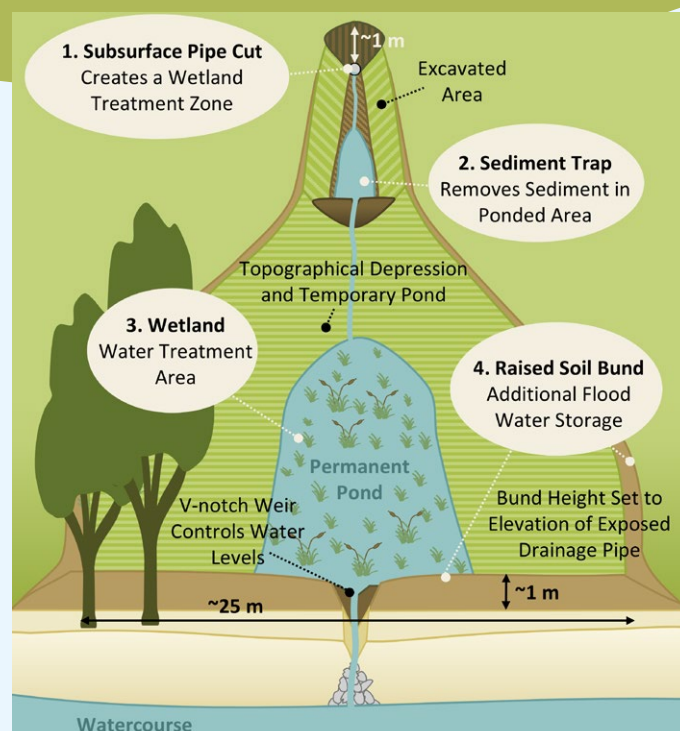


Figure 1: 3D wetland buffer schematic showing creation of a wetland from excavated subsurface drainage to reduce nutrient pollution and increase flood storage.

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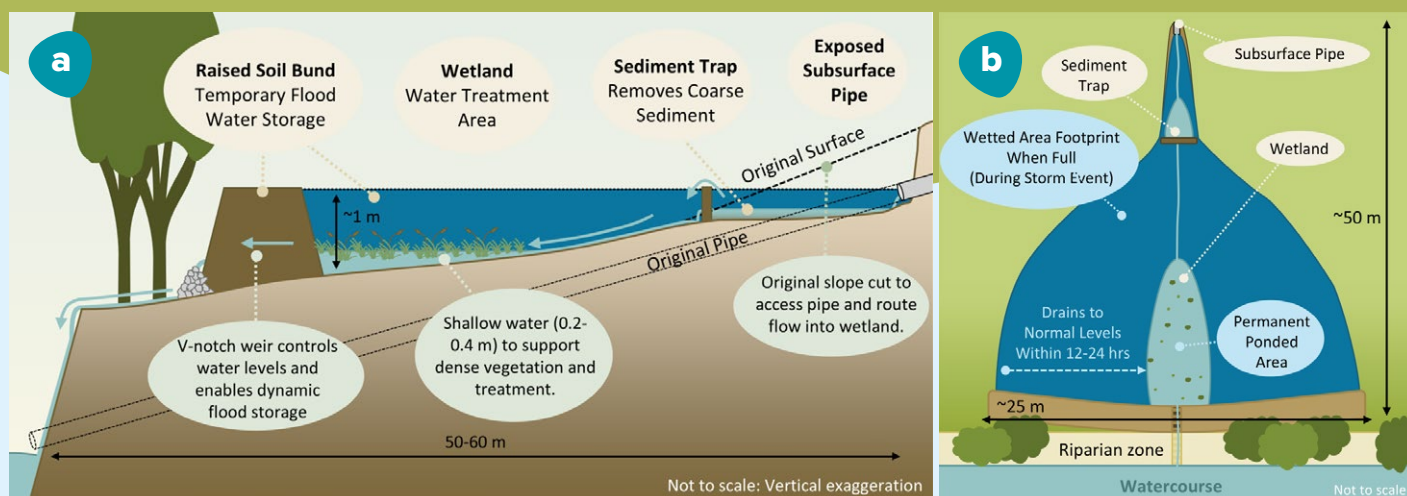


Figure 2: 3D Wetland Buffer Schematics. (a) Cross-section illustrating key design principles and processes for phosphorus and nitrate removal from agricultural diffuse pollution. (b) Plan view showing the wetted footprint of the wetland under normal and storm flow conditions.

Design and Maintenance

- > Wetland area should be 1–5% of the contributing area to achieve effective treatment.¹
- > Performance is strongly influenced by residence time; larger wetlands relative to catchment size provide better contaminant removal.
- > Landowner should inspect sediment traps regularly and remove sediment once ~50% full.
- > Inspect for even flow distribution and signs of erosion, channelisation, or bypassing.
- > Control invasive species and fence to prevent livestock access to wetland pond.
- > Management to optimise nutrient removal can reduce biodiversity.

NbS Measure Summary

Aspect	Notes
Set-up cost	Moderate to high depending on scale, design and earthworks (cost falls with scale). ^{2,3}
Maintenance effort	Annual checks, periodic sediment removal and vegetation management. ^{1,3}
Lifespan	Multi-decadal when sediment accumulation and structures are managed. ^{1,3,4}
Flow attenuation	Reduces and delays local peak flows through temporary storage; effect is site-specific. ^{1,3,4}
Sediment retention	High for suspended solids due to sediment traps at the inlet. ^{1,2}
Phosphorous (P) removal	Effective for particulate P via sedimentation; dissolved P removal is variable. ^{1,4,5}
Nitrogen (N) removal	Reliable N removal via denitrification where residence time, anoxic zones and carbon supply are adequate. ^{3,6}

Further Information

- ¹ NIWA (2020). Constructed wetlands to reduce contaminant loss from pastoral farms. Key design guidelines and performance estimates. (G) (PDF Link)
- ² Ó hUallacháin et al. (2025). Effectiveness of Riparian Mitigation Measures for Enhancing Ecosystem Functions: A Holistic Summary of Selected Measures. Environmental Management, 1-16. (R)
- ³ Land et al. (2016). How effective are created or restored freshwater wetlands for nitrogen and phosphorus removal? A systematic review. Environmental Evidence, 5(1), 9. (R)
- ⁴ Carstensen et al. (2020). Efficiency of mitigation measures targeting nutrient losses from agricultural drainage systems: A review. Ambio, 49, 1820-183. (R)
- ⁵ Webb et al. (2025). Phosphorus Removal in Constructed Treatment Wetlands: A Systematic Review. Water, 17(22), 3301. (R)
- ⁶ Martínez-Espínosa et al. (2021). Denitrification in wetlands: A review towards a quantification at global scale. Science of the total environment, 754, 142398. (R)

G = Guidance, R = Research

MATCH FUNDERS



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