



Offline Storage Pond

Raised earth banks and depressions providing temporary ponding of channel water during high flow events.

Overview

Offline storage ponds are shallow floodplain basins formed by low earthen bunds that temporarily store floodwater during high flows, releasing it gradually as channel levels recede.

Primary Function

Attenuate peak flows and encourage sediment deposition.

Location Considerations

- > Best suited to low-gradient floodplains with natural depressions or flat areas to maximise storage and minimise earthworks.
- > Often integrated into wide riparian buffer strips or low-intensity grassland where continued agricultural use is feasible.
- > Must be located where floodwater can be safely diverted and retained without risk to infrastructure or property.

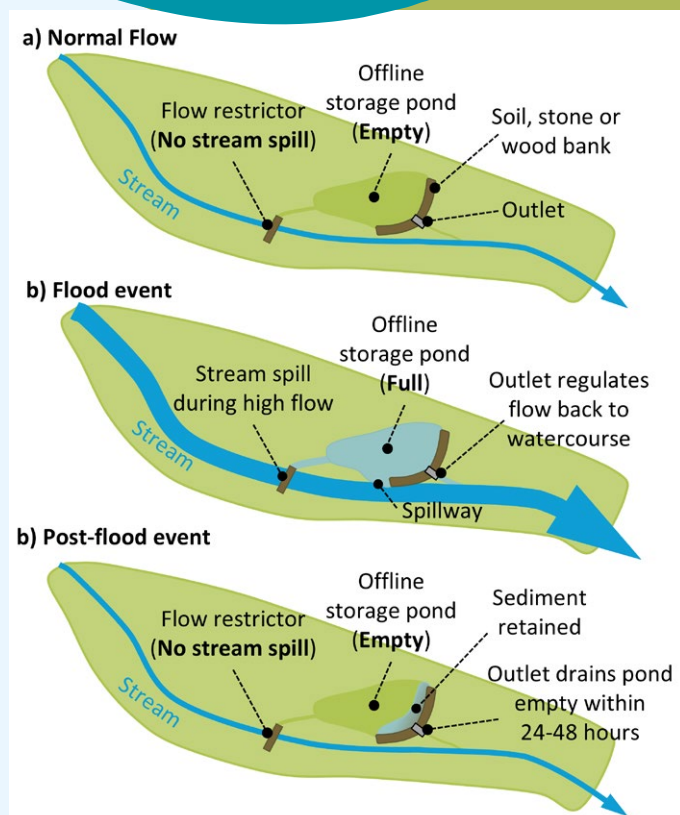


Figure 1: Offline storage pond schematic showing (a) the empty basin during normal flows, (b) diversion of high flows into the pond via a flow restrictor during storm events, and (c) post-event drainage and sediment deposition within the pond footprint.

How They Work

- 1. Flow Diversion and Temporary Storage**
During high-flow events, water is diverted from the main channel into adjacent floodplain basins formed by low earthen bunds.
- 2. Sediment and Nutrient Retention**
As water ponds in the depression, coarse and fine sediments settle to the bottom, trapping particulate phosphorus.
- 3. Controlled Water Release and Peak Flow Reduction**
Stored water is gradually released back to the watercourse through outlets or infiltration, reducing peak flows downstream and lowering flood risk.
- 4. Short-Term Ponding (24–48 hrs)**
Ponds are designed to drain empty within 24-48 hours, allowing the land to be utilised for farming most of the year.

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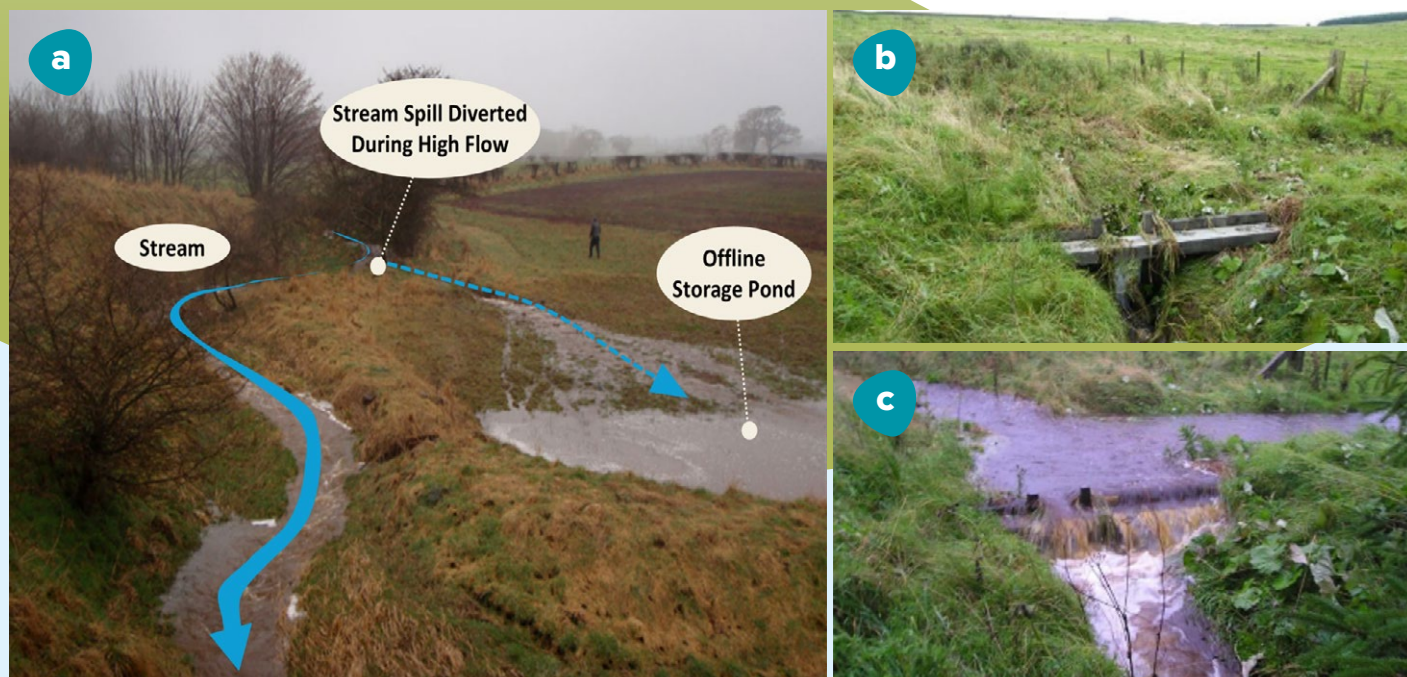


Figure 2: Offline storage pond schematic. (a) Stream spill is diverted into the pond during high flows using a flow restrictor (adapted from Nicholson et al., 2020). (b–c) Photographs of the flow restrictor during normal flow (b) and a flood event (c) (photo: Mark Wilkinson, JHI).

Design and Maintenance

- > If constructed as an earthen bund (the most common approach), the bund height should typically not exceed 1m.¹
- > Tools such as TSA-DOT can guide design by optimising the storage-to-drainage relationship based on storage capacity, contributing area, and the target storm event.²
- > Storage capacity should not exceed 10,000m³ to comply with reservoir legislation.³
- > Landowners should inspect bunds after storm events for signs of erosion, structural weakness or blockages.¹
- > Installing sediment traps helps maintain storage capacity, while subsurface drainage prevents prolonged ponding.⁴

NbS Measure Summary

Aspect	Notes
Set-up cost	Cost varies with construction material (e.g. timber, soil bund) and excavation requirements. ¹
Maintenance effort	Soil management may be needed to maintain infiltration or storage capacity. ⁴
Lifespan	Lifespan depends on sedimentation rate and construction material.
Flow attenuation	Provides local peak-flow reduction; networks of ponds deliver greater cumulative attenuation. ^{2,5}
Sediment retention	Captures suspended sediment, but an upstream sediment trap improves function and longevity. ⁶
Phosphorous (P) removal	Strong particulate P removal via sediment settling, enhanced by a higher positioned outlet pipe. ⁶
Nitrogen (N) removal	Limited evidence: some removal via plant uptake and denitrification in anoxic zones.

Further Information

- Wren et al. (2022) The natural flood management manual, C802, CIRIA, London, UK (ISBN: 978-0-86017-945-0) (G)
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- Nicholson et al. (2020). The potential of runoff attenuation features as a Natural Flood Management approach. Journal of Flood Risk Management, 13, e12565. (R)
- Robotham et al. (2023). Nature-Based solutions enhance sediment and nutrient storage in an agricultural lowland catchment. Earth Surface Processes and Landforms, 48(2), 243-258.

G = Guidance, R = Research

MATCH FUNDERS



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