Appendix A13.6: SuDS Design Principles

1 Introduction

1.1.1 This appendix provides the principles and example designs of SuDS wetlands, retention ponds and swales based on the latest good practice guidance. These design principles are required to be adopted as part of the detailed design and construction of the proposed scheme.

1.1.2 SuDS features are required throughout the proposed scheme in order to provide attenuation of peak flows and to treat surface water runoff before it enters watercourses. They are required in a range of different landscape character types traversed by the proposed scheme including relatively wooded lower glen and largely open mid glen. Careful consideration must be given to the local landscape context and topography when designing these features to ensure a good landscape fit. Geo-cellular storage areas have been incorporated into the design at appropriate locations to increase the water retention capacity.

1.1.3 The Construction Industry Research and Information Association (CIRIA) has published the SuDS Manual (2015) which sets out the four pillars of SuDS design - water quantity, water quality, amenity and biodiversity. The SuDS Manual guidance promotes the early consideration of the criteria in the design process to obtain the best multi-functional outcome. Well implemented SuDS design can have very positive impacts on visual amenity, biodiversity and land value.

1.1.4 The Chartered Institution of Water and Environmental Management (CIWEM) and the Wildfowl and Wetlands Trust (WWT) have recently published new research (2017) assessing the effectiveness of delivering multifunctional sustainable drainage in England. One of the report findings was that where SuDS have been delivered, they often miss opportunities to provide multiple benefits beyond the basic function of control, treatment and attenuation of surface water.

1.1.5 Water quality and quantity considerations within this embedded scheme SuDS design are discussed in Appendix A11.6 of the ES.

2 SuDS Design Objectives

2.1.1 The following design objectives should guide the detailed design of the SuDS features along the proposed scheme:

- Maximise multi-functionality.
- Support and protect natural local habitats and species.
- Contribute to habitat connectivity and to the delivery of local biodiversity objectives.
- Create diverse, self-sustaining and resilient eco-systems.
- Create visually attractive landscape features, which respect and are integrated into the surrounding landscape character and qualities of the A9 corridor.
- Mitigate adverse visual impacts on landscape and visual receptors by using natural characteristics in design and sensitive methods to mitigate adverse visual and environmental impacts.
- Integrate with surrounding topography through appropriate orientation and shaping, with minimum cutting and filling and grading out of side slopes.
- The form of drainage features should relate to the meanders of water courses. The detention basins and retention ponds are to have a varied, naturalistic edge and slopes graded out with varied slope angles. Straight edges are generally unacceptable; instead varied, naturalistic edges are to be designed to fit with local topography.
- Achieve naturalistic appearance, except where drainage features are specifically required to fit with more formal ‘man-made’ local landscape characteristics or provide a formal landscape feature.
- Ensure ‘low key’ design of associated structures such as access paths to minimise visual impact.

- Plant with native marginal and emergent aquatic species and native terrestrial vegetation suitable to local context to provide wildlife habitat and visual interest.

Detention Basins

General Design Requirements

2.1.2 The drainage system should be designed such that the SuDS detention basins occupy naturally low lying areas and where possible perimeter access tracks should be at existing grade or in cutting to avoid a bunded appearance. Where access tracks and paths are required to be on embankment, the outer slopes should be graded out to varied slope angles to tie in with the surrounding landform, and where necessary planted to integrate the slopes into the landscape.

2.1.3 The gradients of the SuDS basin inner slopes should be varied along their length to reflect the naturally occurring topography of the immediate surroundings. These bank slopes should be no steeper than 1:3 at any point and for least 50% of the slope plan area should be 1:5 or shallower. Slopes should have varied microtopography and straight batters should be avoided. The localised compression and loosening of the soil will also allow a variety of different plant communities to establish. This may require sections of the access track/path to be pulled away from the SuDS to provide sufficient space. The access track should be surfaced with crushed stone to reduce its visual impact.

2.1.4 The following principles should also be followed:

- Temporarily wet areas of the bank slopes to be sown with species rich / wet grassland seed mixes. Example wet grassland species include sneezewort, common knapweed, marsh thistle, meadowsweet, meadow crane's-bill (in lowland locations), water avens, common cat's ear, yellow iris, ox-eye daisy, greater bird's-foot trefoil, ribwort plantain, selfheal, meadow buttercup, common sorrel, autumn hawkbit, ragged-robin, devil's-bit scabious, common bent, meadow foxtail, oval sedge, jointed rush, heath rush, tufted hair-grass, chewings fescue and smooth-stalked meadow grass.
- No tree or shrub planting below maximum water level.
- Flatter areas in the base of the basin to be planted with native marginal aquatic species (e.g. water plantain, bottle sedge, common spike-rush, meadowsweet, water avens, small sweet-grass, floating sweet-grass, marsh pennywort, yellow iris, jointed rush, greater bird's-foot trefoil, purple-loosestrife, water mint, water forget-me-not, lesser spearwort, water-cress, ragged-robin and brooklime). Wet grassland species would also be suitable for margins. Lesser bulrush and great reedmace should be avoided as it can quickly dominate.
- Landscape Architect to be included in detailed design team.

2.1.5 See Figures 1 and 2 below for example designs of a detention basin.

Retention Ponds and Wetlands

General Design Requirements

2.1.6 The drainage system should be designed such that the SuDS retention ponds and wetlands occupy naturally low lying areas and where possible perimeter access tracks should be at existing grade or in cutting to avoid a bunded appearance. Where access tracks and paths are required to be on embankment, the outer slopes should be graded out to varied slope angles to tie in with the surrounding landform, and where necessary planted to integrate the slopes into the landscape.

2.1.7 The gradients of the SuDS pond/wetland bank slope between the access track/path and the permanent water level should be varied along their length to reflect the naturally occurring topography of the immediate surroundings. These bank slopes should be no steeper than 1:3 at any point and for least 50% of the slope plan area should be 1:5 or shallower. Slopes should have varied microtopography and straight batters should be avoided. The localised compression and loosening of the soil will also allow a variety of different plant communities to establish. This may require sections of

the access track/path to be pulled away from the SuDS pond/wetland to provide sufficient space. The access track should be surfaced with crushed stone to reduce its visual impact.

2.1.8 The gradients of the slopes below the permanent water level should be no steeper than 1:3 and ledges and shallows with a permanent water depth of up to 0.3m should be included over no less than 10% of the permanent wet pond/wetland's surface area.

2.1.9 The preferred maximum water depth of the SuDS pond/wetland should be between 0.6m and 1.2m, with a maximum permissible depth of 2m.

2.1.10 The SuDS pond/wetland should include multiple areas of open water separated from each other by permeable 'berms' of low-lying ground to allow water to filter between the open water areas. The permanently wet areas of the wetland should have a varied outline with irregular shaped promontories, embayments and islands to increase the length of the wet margin and the distance over which the water must travel between the inlet and the outlet, forcing it to flow through areas of emergent vegetation within shallows thus enhancing the level of treatment, and achieving loose, flowing shapes particularly in areas with flatter topography.

2.1.11 The SuDS pond/wetland should include a forebay to trap sediment immediately beneath the inlet occupying an area of approximately 10% of the permanent SuDS pond/wetland's surface area. The following principles should also be followed:

- Permanently 'wet' retention pond water volume to be calculated using the treatment volume equation for Scotland (SuDS Scottish Working Party, 2009).
- Temporarily wet areas of the sloping banks to be sown with species rich/wet grassland.
- No tree or shrub planting below maximum water level.
- Flatter areas around the permanent water margin to be planted with native marginal aquatic species (e.g. water plantain, bottle sedge, common spike-rush, meadowsweet, water avens, small sweet-grass, floating sweet-grass, marsh pennywort, yellow iris, jointed rush, greater bird's-foot trefoil, purple-loosestrife, water mint, water forget-me-not, lesser spearwort, water-cress, ragged-robin and brooklime). Wet grassland species would also be suitable for margins. Lesser bulrush and great reedmace should be avoided as it can quickly dominate.
- Include native aquatic, emergent and marginal species (apart from the marginal species mentioned above, examples of suitable emergent and floating species include Branched bur-reed, white water-lily, amphibious bistort and broad-leaved pondweed; wetlands to include a higher density of planting.
- Landscape Architect to be included in detailed design team.

2.1.12 See Figures 3 to 6 for example designs of a SuDS retention pond and a SuDS wetland.

Dry Swales

General Design Requirements

2.1.13 The drainage system should be designed such that the swales occupy naturally low lying areas and where possible access to these should be at existing grade or in cutting to avoid a bunded appearance.

2.1.14 The gradients of the slopes below the permanent water level should be no steeper than 1:4 where possible to maximise contact with vegetation and thereby enhance treatment, reduce erosion risk and facilitate mowing.

2.1.15 Swales should generally be designed with a width of 6.8m, a base width of 2.0m and a depth of 150mm, with a maximum depth of 600mm.

2.1.16 The following design principles should also be followed:

- Temporarily wet areas of the slopes of grass channels should be capable of withstanding periodic inundation as well as extreme dry conditions. Planting species should include water tolerant native grasses, fine-growing grasses, which would provide shelter and a place for to forage and breed for invertebrates, birds and mammals.
- Water should only be routed through once grass is established.
- Planting should be salt tolerant where adjacent to roads regularly salted during winter months.
- Landscape Architect to be included in detailed design team.

3 Planting Design

3.1.1 Although the SuDS detention basins, retention ponds/wetlands and dry swales are likely to be naturally colonised by vegetation, it is preferable to ensure a quicker effect for the purposes of visual amenity by planting and seeding the SuDS features with species appropriate to the local context. The following principles should be followed:

- Native plant species/assemblages/communities tolerant of wet and dry conditions are to be used.
- Planting should mimic plant communities that are found within natural systems in the locale (wetlands and marshy areas) and be of local provenance.
- Planting design is to take naturalistic form to provide visual and ecological enhancement.

4 References

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SEPA (2017). Regulatory Method (WAT-RM-08) Sustainable Urban Drainage Systems (SUDS or SUD Systems) Version: v6.1. Available at http://www.sepa.org.uk/media/219048/wat-rm-08-regulation-of-sustainable-urban-drainage-systems-suds.pdf

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Woods Ballard, B., Wilson, S., Udale Clarke H., Illman, S., Scott, T., Ashley, R., Kellagher, R. 2015. The SuDS Manual. CIRIA. Available at http://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

CIRIA (2017). Guidance on the construction of SuDS (C768)

Figure 1: Dry basin example plan

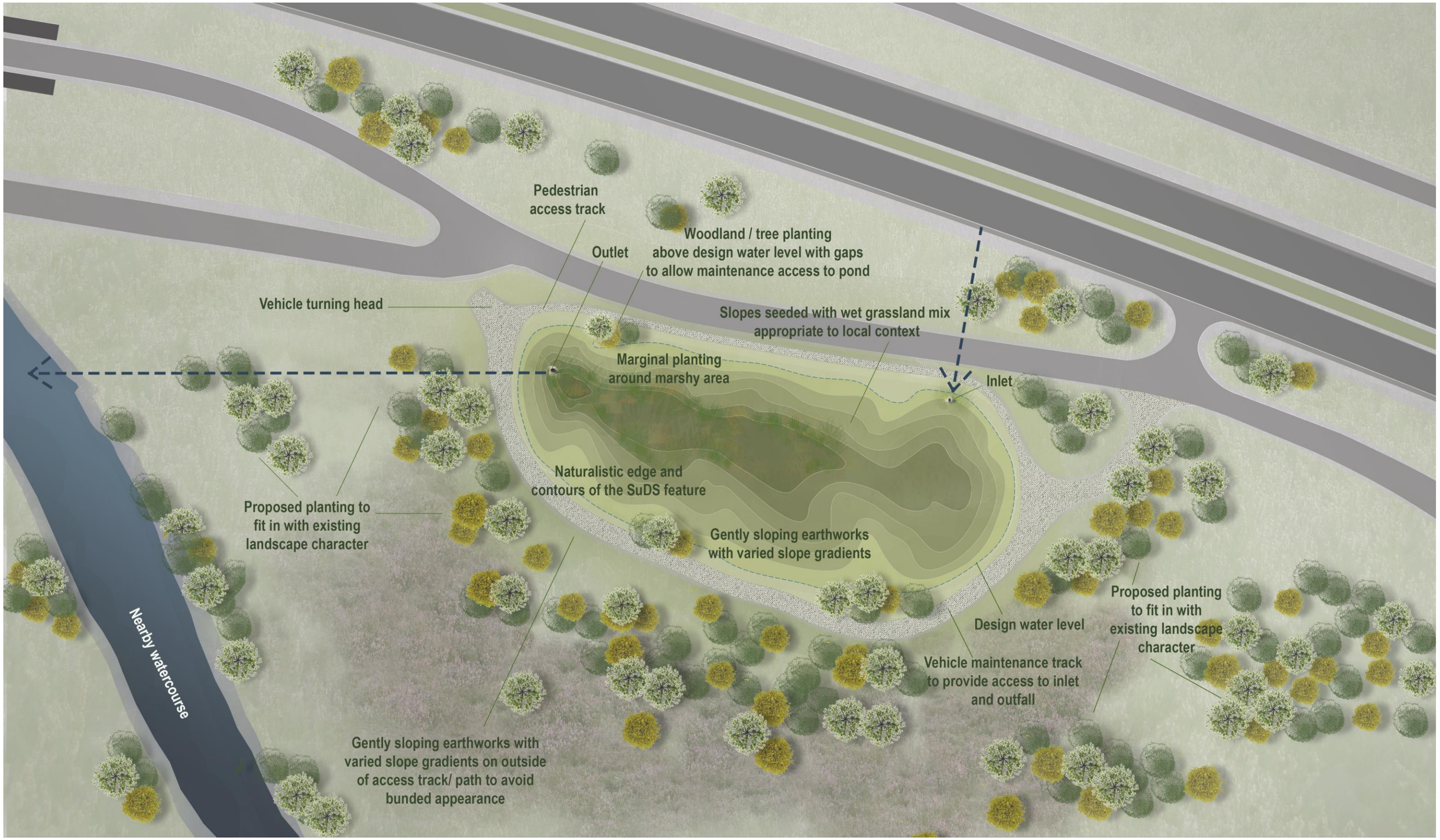

Figure 2: Dry basin example cross-section

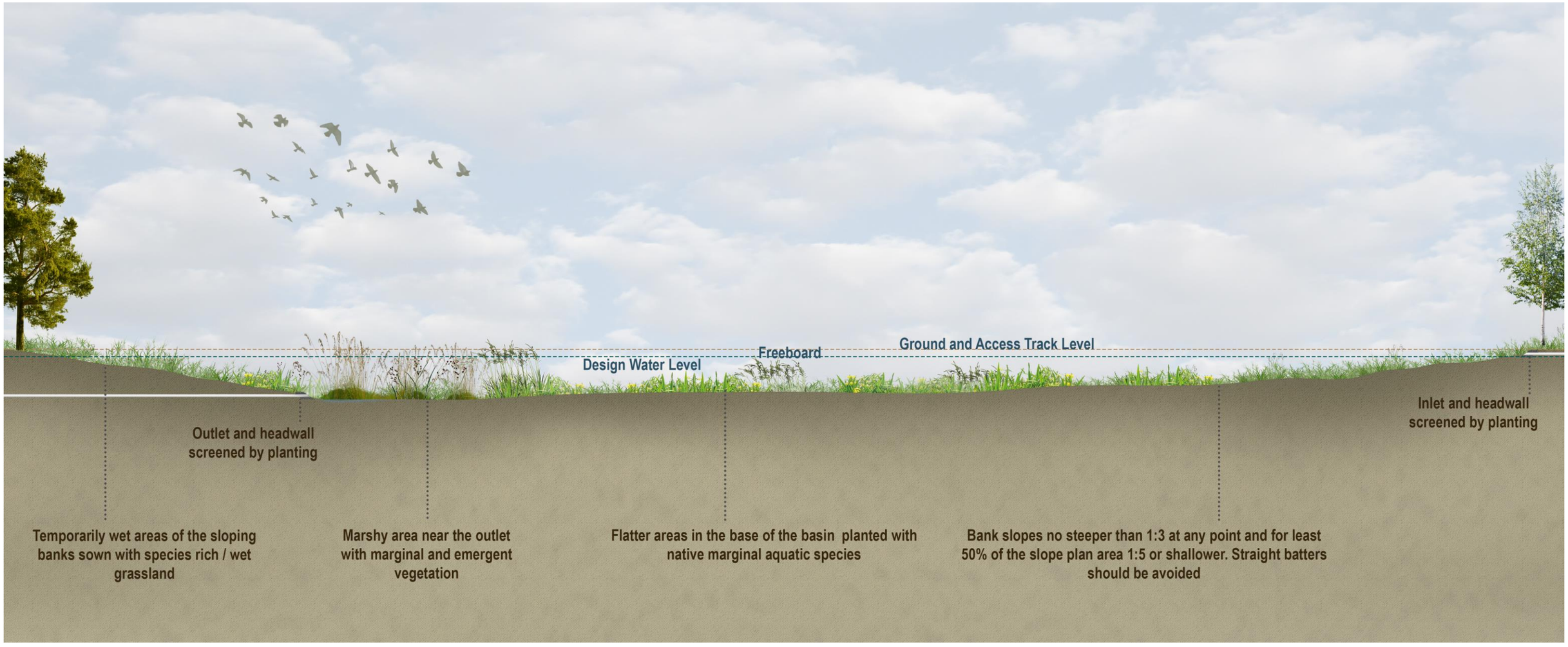

Figure 3: Retention pond example plan

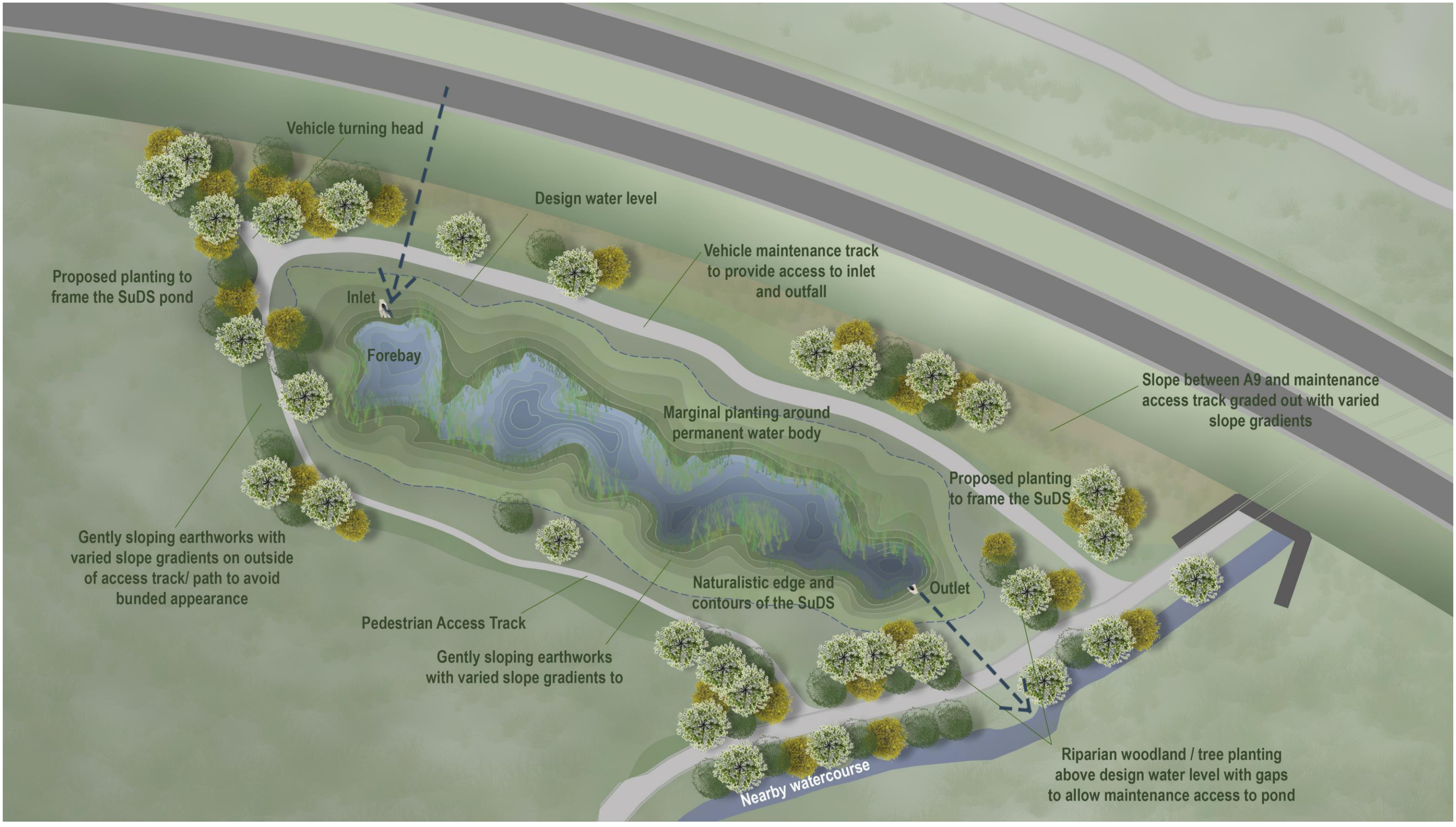

Figure 4: Retention pond forebay example cross-section

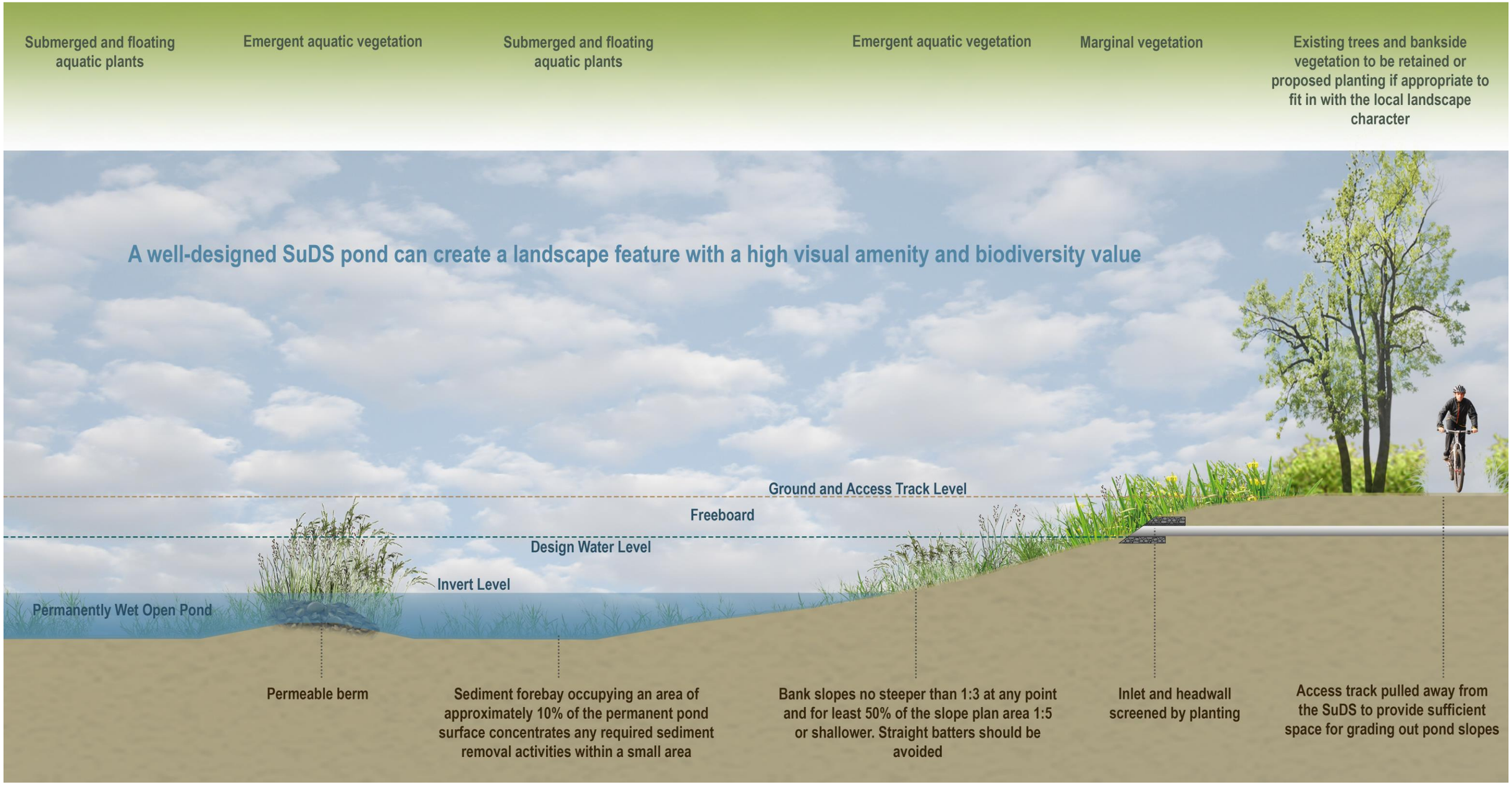

Figure 5: Wetland example plan

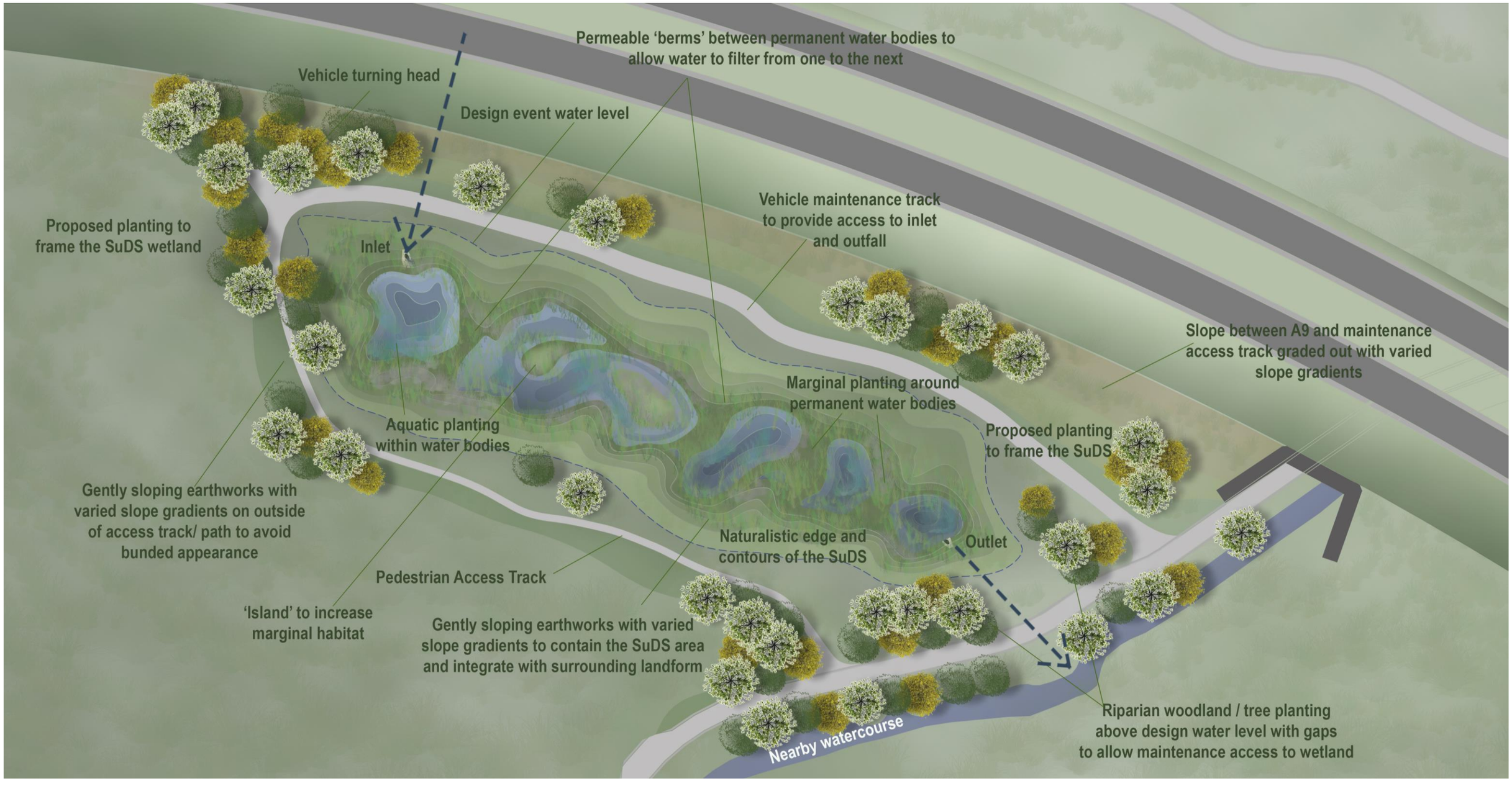

Figure 6: Wetland example cross-section

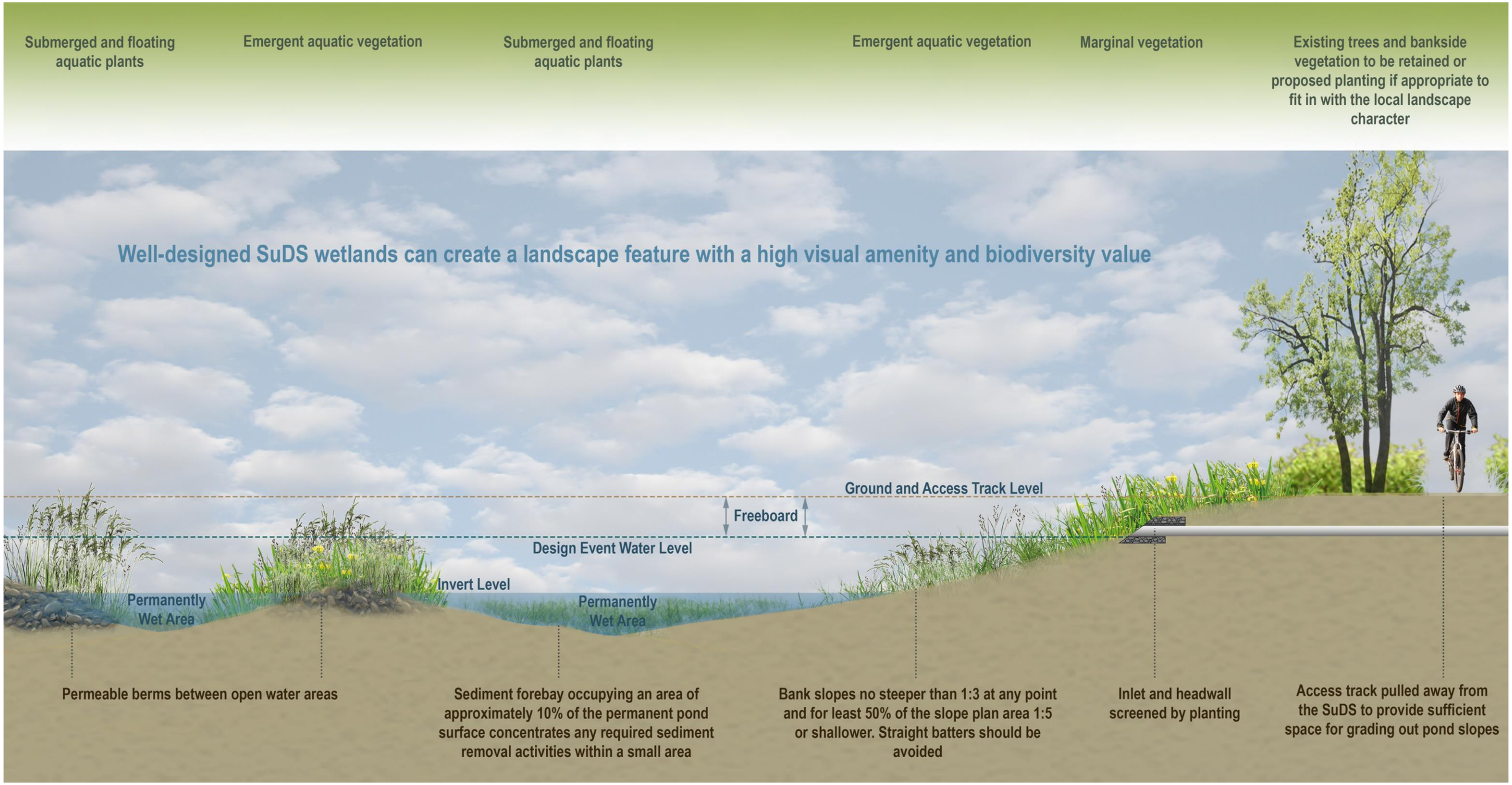

Figure 7: Dry swale example cross-section