



DWR – NPDES-SOP – G – 16 –Erosion Prevention and Sediment Control Handbook – 01092026

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4.3.5 Level Spreader



Source: Ohio State Stormwater Management Program

Definition and Purpose

A level spreader is a flow control measure that receives concentrated flow and converts it to sheet flow. It is essentially a broad, level outlet structure, such as a weir, that dissipates flow energy and downstream erosion potential. Additionally, a secondary benefit of level spreaders is that they can infiltrate runoff and reduce pollutants such as sediments and nutrients (Winston et al., 2011). Level spreaders are more effective when vegetation is incorporated into the design.

Appropriate Applications

Level spreaders are best suited for locations where sediment-free stormwater runoff can be discharged evenly onto stable, vegetated slopes without causing erosion. They are particularly effective where the downstream area has a uniform grade of 10% or less and is free of surface irregularities. Ideal sites include areas where the natural slope directs flow away from the project site and where the released runoff will not reconcentrate or be subjected to traffic. Level spreaders are also appropriate as outlets for temporary or permanent stormwater control features with concentrated flows. They are especially useful when it is necessary to avoid disturbing riparian buffers with an outfall or outlet protection.

Limitations and Maintenance

One of the primary limitations of level spreaders is the necessity for the weir lip to remain completely level; any irregularities in the weir profile can result in concentrated flows that undermine the device and contribute to erosion. This is particularly a concern during freeze-



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thaw cycles. Level spreaders should never be installed at or above the finished grade of adjacent surfaces. Furthermore, level spreaders are not well-suited for distributing concentrated flows exceeding 30 cubic feet per second (NCDEQ, 2013; VDEQ, 2024).

During construction and until vegetation becomes established, inspections are most helpful after each storm to identify and repair any low points, cracks, or debris accumulation that could compromise performance. Regular tasks include maintaining the weir at zero grade, clearing debris, mowing to preserve healthy vegetation, and ensuring there is no subsidence or erosion downstream. In addition, removal of sediment buildup behind the level spreader should be done once the capacity has reached 50%. The spreader location needs to be accessible for easy maintenance yet separated from pedestrian and traffic routes.

Planning and Design Considerations

Implementing level spreaders on construction sites requires careful planning to ensure their effectiveness and longevity. These low-cost outlet structures work best in small drainage areas with concentrated flow rates under 30 cubic feet per second, making them well-suited for managing runoff from dikes, diversions, channels, swales, slope drains, etc. A completely level outlet lip is critical to maintain uniform sheet flow; any low points or irregularities may cause the flow to reconcentrate and trigger erosion. It is good practice to use a laser level for verification of proper installation. Standard practice allows for a tolerance of up to a quarter inch per 25 feet of length. In higher flow conditions, a rigid lip design helps sustain proper flow dispersion. Where runoff carries significant sediment, directing it first through sediment control measures helps prevent buildup and preserves the spreader function.

In addition to the level spread itself, the total system includes a channel and a vegetated filter strip (Section 4.4.3) as well as an optional forebay (Figure 4.3.5-A).

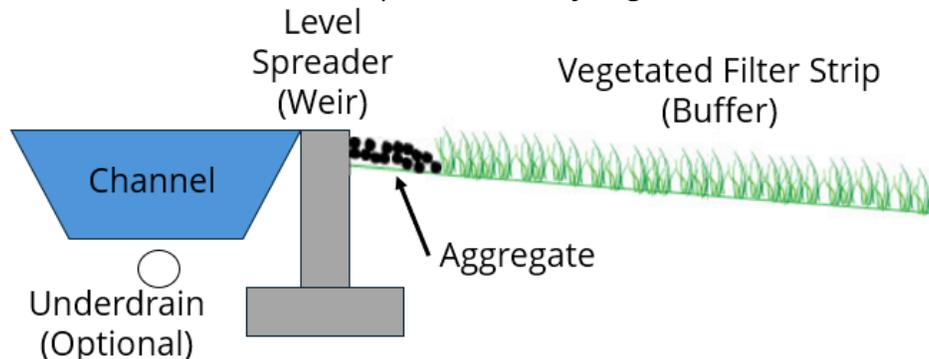


Figure 4.3.5-A: Level spreader schematic. Source: Ohio State Stormwater Management Program.



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A forebay may be used as pretreatment before the level spreader. It is an excavated, bowl-shaped feature that slows the influent runoff and allows larger sediments and debris to settle and may be defined by a porous barrier such as a check dam, baffle, or rock berm. The forebay may be lined with conventional riprap to reduce erosion in the excavated area. Forebays dissipate energy and reduce the sediment accumulation behind the level spreader.

After stormwater passes through the forebay, it enters a concrete, rock, or grassed channel, the main body of the level spreader. The channel is a long, shallow impoundment that fills to the level of its lower side. The lower side (the *downslope side*) of the channel is constructed so that it is level along its full length. This lower side, or level spreader lip, is often constructed of concrete or rock so that it resists erosion. As stormwater enters the channel, it rises to smoothly meet the width of the level spreader to ensure uniform overflow. To ensure a smooth transition from the channel to the level spreader, a minimum channel width of six feet is often advised (VDEQ, 2024, TDOT), and depths can be specified from Table 4.3.5-A.

Table 4.3.5-A: Minimum channel depths (feet) for level spreaders based on design flows and downgradient slopes. Source: TDOT.

Design Discharge (cfs)	Downgradient Slope (%)			
	0 - 4	4 - 6	6 - 8	8 - 10
1	1.5	1.5	1.5	1.5
2	1.5	1.5	1.7	2
4	1.5	1.8	2.5	3
7	1.9	2.5	3.5	4.1
10	2.3	3.1	4.2	-
15	3	3.9	-	-
20	3.5	4.5	-	-
25	3.9	5.2	-	-
30	4.3	5.7	-	-

Finally, runoff enters a vegetated buffer. As runoff passes through the buffer vegetation, some of the water infiltrates. When properly vegetated, the buffer can remove sediment and nutrients from runoff before leaving the site and entering a downstream waterbody (Winston et al., 2011).

The level spreader structure is to be designed such that the channel behind it drains in approximately 24 hours. A general rule of thumb is to achieve a drawdown rate of half an inch per hour. The length of the level spreader, which acts as a broad crested weir, can be calculated using Eqn 17 (Section 4.3.3.1) by restricting a flow depth above the level spreader and calculating the peak flow rate using the design storm and approved methodologies



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(Section 2.1.3). A flow depth of one foot has been recommended (Winston et al., 2011). Alternatively, and more simply, the weir length can be calculated by dividing the design peak flow rate by a unit weir flow rate (Table 4.3.5-B).

Table 4.3.5-B: Unit weir flow rates (cubic feet per second per linear foot) used to calculate level spreader weir lengths. Source: TDOT.

Downgradient Slope (%)	Unit Weir Flow Rate (cfs/LF)
0 - 4	0.49
4 - 6	0.2
6 - 8	0.07
8 - 10	0.04

Ideally, the ground surface on the downstream side of the level spreader should sit flush with the weir crest. Where this is not achievable, lay #57 stone or similar aggregate at a 4H:1V (or shallower) slope until the two are flush.

All level spreaders must discharge runoff in a straight or convex manner to decrease the chances of re-concentrated flow downgradient. (Figure 4.3.5-B). Furthermore, ensure the downgradient slope is promptly re-seeded and mulched if the area was disturbed. Lastly, level spreaders can be constructed from various materials such as concrete, wood, and earth. It is usually ideal to line the level spreader with an erosion-resistant material if it is not constructed with concrete.

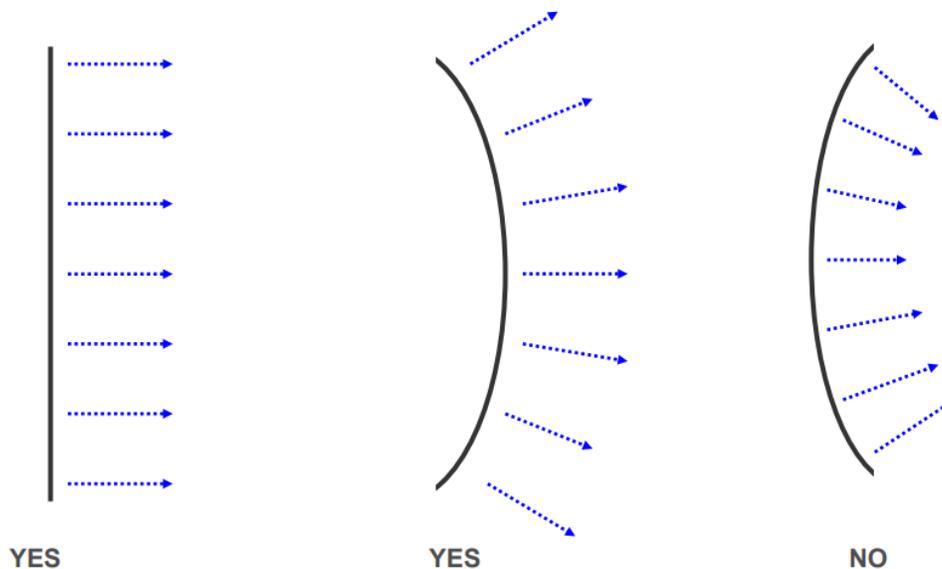


Figure 4.3.5-B: Allowable level spreader discharge patterns. Source: Ohio State Stormwater Management Program.



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Example Application

-Example courtesy of TDOT-

Given:

A proposed area of 0.8 acres is to be developed, which drains to an ETW. A proposed ditch will convey a design peak flow of 4.8 cubic feet per second. A designer wishes to install a level spreader at the end of the ditch where the rest of the land is sloped at 1% towards the ETW.

Determine:

The depth of the channel upgradient of the level spreader and the length of the level spreader weir.

Solution:

Interpolating from Table 4.3.5-A yields a required depth of about 1.6 feet.

From Table 4.3.5-B, a unit weir flow rate of 0.49 cfs/LF is required for the design. By dividing the design flow rate of 4.8 cfs by the unit weir flow rate factor, a length of 9.8 feet is computed. Round up to 10 feet of length.

References

NCDEQ. (2013). *Erosion and Sediment Control Planning and Design Manual*.

Ohio State Stormwater Management Program (2020). *Level Spreader – Filter Strips*. Course Content: ENVENG 5194.

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VDEQ. (2024). *Virginia Stormwater Management Handbook*.

Winston, R. J., Hunt III, W. F., Osmond, D. L., Lord, W. G., & Woodward, M. D. (2011). Field evaluation of four level spreader-vegetative filter strips to improve urban stormwater quality. *Journal of Irrigation and Drainage Engineering*, 137(3), 170-182.