
Greenville County Technical Specification for:
WQ-13 LEVEL SPREADER

1.0 Level Spreader

1.1 Description

Use Level Spreaders to disperse concentrated runoff uniformly over ground surfaces as sheet flow. Use Level Spreaders for peak design flow rates up to 10 cubic feet per second (cfs). Level Spreaders are constructed at a zero percent grade across a slope and typically consist of a permanent concrete weir structure used to disperse or spread concentrated flow thinly over a Vegetated Filter Area. Residential sites may use alternative materials to construct the weir structure at zero percent grade as described in Section 1.3.4. The main function of a Level Spreader is to spread potentially erosive concentrated flow over a wide area so that erosion does not occur at the outlet. When designed and installed correctly, sheet flow is achieved downstream of the Level Spreader. Additional benefits include increased infiltration and increased pollutant and nutrient removal. Level Spreader components include:

- High Flow Splitter
- Forebay
- Level Spreader Swale
- Underdrain
- Level Spreader Lip
- Vegetated Filter Area
- Bypass Conveyance Channel

Use Level Spreaders to convey runoff from impervious surfaces and pipe outfalls uniformly onto Vegetated Filter Areas or onto stream buffers. Level Spreaders are applicable:

- At outlets for diversion structures.
- In areas requiring a Vegetated Filter Area to treat runoff.
- As a segment of a stormwater BMP treatment series.
- Where runoff from an impervious surface is uneven and/or runoff is released as concentrated flow, such as through curb cuts or slope drains.

Do not use Level Spreaders:

- Where discharge slopes exceed 6% for wooded/forested filter areas or 8% for thick ground cover/grass filter areas.
- Where there is a draw, low point, or channel located within the Vegetated Filter Area down slope of a proposed Level Spreader.
- Where the runoff water will re-concentrate after release from the Level Spreader before reaching an outlet designed for concentrated flow.
- Where there will be traffic over the Level Spreader.

1.2 Design

See Details WQ-13A and WQ-13B for design requirements, key dimensions, and required inputs to be provided by the design engineer.

For water quality applications, the required method to design a Level Spreader as part of a treatment train with other water quality BMPs is to use the Greenville County IDEAL Model to demonstrate overall site compliance with applicable County water quality standards. See County Design Manual for site-specific applicable water quality standards.

Depending on the site layout and flows, Level Spreader system components may include a high flow splitter, a bypass conveyance, and a pre-treatment forebay. Level Spreaders not discharging to a specific stormwater BMP or designed stormwater conveyance system must discharge to a Vegetated Filter Area.

Use Level Spreaders as a stand-alone BMP, or with other BMPs in series to treat stormwater runoff using a treatment train. Flow, slope, site constraints, and design considerations dictate which method is used. Consult other Greenville County Specifications for further guidance on design, installation, maintenance, and modeling of other BMPs in the treatment train system.

Ensure the Level Spreader design accounts for runoff at ultimate build-out, including off-site drainage. Flows to the Level Spreader must not exceed the design flow of the specific Level Spreader application and must not exceed 10 cfs in any application. Bypass all flows greater than the design flow through a stabilized Flow Bypass Conveyance.

Level Spreader dimensions are derived from the design flow (cfs). Table 1 shows the minimum depth and minimum length of the Level Spreader Lip based on design flows.

Table 1: Level Spreader Dimensions

Design Flow (cfs)	Minimum Level Spreader Swale Depth (ft)	Minimum Level Spreader Swale Top Width (ft)	Level Spreader Lip Length (ft)	Minimum Lip Length (ft)
0-10	1.0	3.0	10 feet per cfs	30

Design the Level Spreader Swale to handle the expected peak flow rates with a minimum bottom width of 1-foot with side slopes of 1H:1V or flatter and a minimum top width of 3 feet. The Level Spreader Swale has a maximum grade of 0.5%. Tie the ends of the level spreader into higher ground to prevent flow around the spreader.

A Forebay is used to collect the runoff before the water is sent to the Level Spreader Swale. Design the forebay area to be 0.5% of the contributing impervious drainage area. The depth is 3 feet at the deepest point and decreases to 1 foot as the forebay approaches the level spreader swale.

1.3 Components

1.3.1 Forebay

Use a Forebay for the preliminary treatment of stormwater allowing sediment to settle out. Excavate the Forebay as a bowl shaped feature to slow the influent before it reaches the Level Spreader Lip. Reinforce the Forebay with turf reinforcement matting (TRM) or Class A (6-inch diameter) riprap.

1.3.2 Level Spreader Swale

Immediately downstream of the Forebay, stormwater is discharged into the Level Spreader Swale, a swale on the upstream side of the Level Spreader Lip which is terminated at either end to ensure flow goes over the Level Spreader Lip. Within the Level Spreader Swale, water rises and falls evenly over the Level Spreader Lip, distributing flow evenly over its length. Whenever practical, convey stormwater to the Level Spreader Swale parallel to the Level Spreader Lip to avoid short circuiting. Ensure that any swale lining or protection allows water to infiltrate to the underlying perforated underdrain and prevent standing water. If a pipe-section is utilized for the Level Spreader Swale, adequate holes must be drilled to allow water to infiltrate to the perforated underdrain.

1.3.3 Underdrain

Place a perforated underdrain system beneath the Forebay and Level Spreader Swale as many of the native soils found in Greenville County do not allow for adequate infiltration. In extreme situations where an

underdrain is not feasible due to unique site constraints, infiltration rate must be a minimum 0.5 inches per hour, verified by site specific soil samples at the elevation of the bottom of the excavated Level Spreader Swale where infiltration will occur.

The underdrain drains the Forebay and Level Spreader Swale between storm events to provide capacity for the next storm event, allows the turf to dewater, and avoids mosquito risks. The underdrain must discharge to the stabilized Flow Bypass Conveyance or other stable outlet as determined by site-specific design criteria. It must flow to a stable outlet that daylight (emerges from the ground and is open to the air) or tie into a stormwater conveyance system.

1.3.4 Level Spreader Lip

The Level Spreader Lip is the main body of the Level Spreader that receives water from the forebay, directly from a BMP, or directly from a pipe outlet. Construct the lip so it is level along the entire length. Ensure the lip is a minimum of 6 inches higher than the existing ground on the downslope side, and anchored into the ground appropriately to prevent shifting or settlement. Also ensure the lip has a minimum width of 1-foot in the direction of flow over the top of the lip. Install earthen or concrete berms at each end of the Level Spreader to prevent bypass of runoff.

The Level Spreader must be straight or convex in plan view. Ensure Level Spreaders are not concave in plan view because this concentrates flow downslope of the Level Spreader. To minimize the grading needed to install the Level Spreader, ensure it is placed so that it is parallel to contour lines.

Commercial/Industrial Sites:

Use a Level Spreader Lip made of a poured concrete weir set at a 0% grade.

Residential Sites:

While a poured concrete lip may still be used in this application, the County will allow the use of alternative materials to avoid the use of heavy machinery on residential property where access is limited. Alternative materials must be installed at a 0% grade and anchored in place using pins, earth anchors, stone fill, concrete, or other long-term anchoring strategies.

Suitable materials for Level Spreaders on residential sites include:

- A poured concrete weir set at a 0% grade;
- Manufactured landscape or playground borders/barriers (plastic or recycled material only; no lumber ties or railroad ties); and
- Half-pipe structures made from manufactured pipe sections with a smooth (not corrugated) outer wall and a minimum 1-foot diameter.

1.3.5 Turf Reinforcement Matting (TRM)

The Level Spreader Swale and Forebay may be stabilized with TRM.

1.3.6 Non-woven Geotextile and Stone

Place and anchor a Class 2, Type C nonwoven geotextile on the downslope side of the Level Spreader Lip a minimum of 3 feet and place a 3- to 4-inch layer of #57 stone on top of the geotextile to minimize erosion.

1.3.7 Vegetated Filter Area

After passing over the Level Spreader Lip, stormwater enters a Vegetated Filter Area which may consist of a vegetated filter strip and/or natural undisturbed water quality buffer. See Specification WQ-11 for Permanent Water Quality Stream Buffer requirements and Specification WQ-12 for Vegetated Filter Strip requirements.

Vegetation must be established prior to receiving flow. A temporary stormwater diversion is necessary until the vegetation in the Vegetated Filter Area is stabilized. The Vegetated Filter Area must retain the capacity to pass flow without erosion. Since stable vegetation must be established in the Vegetated Filter Area before the Level Spreader can be put on-line, consider the time of year as construction may be limited to the growing season in order to ensure that a vegetated cover is established.

1.3.8 Flow Bypass Conveyance

Use a flow splitter or diversion box to pass all flows greater than the Level Spreader design flow rate around the Level Spreader and into a stabilized Flow Bypass Conveyance. See Detail RC-06 Flow Splitter for a typical flow splitter configuration. The Flow Bypass Conveyance is a designed conveyance based on site specific constraints and requirements and may be an open channel or closed pipe system.

For open channel Flow Bypass Conveyances, use TRM in place of riprap when possible to stabilize the channel. Add check dams and energy dissipaters as needed to ensure channel is stable. When discharging to a receiving water body, design the discharge point of the Flow Bypass Conveyance at a 30 degree angle downstream into the receiving waterway to minimize erosion and bank degradation.

Discharge the Flow Bypass Conveyance Channel into a deep section of the stream when practicable, and protect stream banks with a TRM or riprap at the discharge point. Other options include discharging to a velocity dissipater, a plunge pool, or a culvert. Site conditions and/or water quality and quantity requirements will guide design decisions for discharging bypass flow.

1.4 Construction Requirements

Construct Level Spreaders on undisturbed soil whenever possible. If the use of fill is unavoidable, compact the fill material to 95% of standard proctor tests. Protect the Level Spreader and downstream Vegetated Filter Area from sediment and stormwater flows during construction. Ensure flows bypass the Vegetated Filter Area until vegetation is established. Avoid driving heavy equipment in the footprint of the Level Spreader. Remove excavated materials from the Level Spreader and Forebay and dispose of them properly.

1.4.1 Site Preparation

Before Level Spreader construction, verify that ground contours are parallel to the Level Spreader location, Vegetated Filter Area slopes are less than 8%, and no draws are located in the Vegetated Filter Area downstream of the Level Spreader. Use only sites with topography that allows a smooth transition from the Level Spreader Lip to the downstream Vegetated Filter Area. Avoid drops or irregular areas that allow water to re-concentrate and erode the Vegetated Filter Area, stream buffer, and possibly the receiving stream.

Ensure there is adequate access around the Level Spreader site to accommodate for post construction inspection and maintenance. Regular maintenance is required for the Level Spreader to function as designed.

1.4.2 Installation

Install Level Spreaders with the following construction sequence when appropriate:

- Install Flow Bypass Conveyance and flow splitter or diversion.
- Temporarily direct all flow to Flow Bypass Conveyance during Level Spreader construction and vegetation establishment.
- Grade Vegetated Filter Area and initiate vegetation establishment.
- Excavate Level Spreader Swale and Underdrain area.
- Install Level Spreader Lip.
- Install Underdrain.
- Install Level Spreader Swale.
- Install Forebay.
- After Level Spreader construction is complete and vegetation is established, direct design flows to Level Spreader.

1.4.2.1 Flow Bypass Conveyance

Install the flow splitter or diversion box according to the design Plans. This structure is installed at the outlet of the watershed prior to the Level Spreader and splits flow between the Forebay and the Flow Bypass Conveyance. Install the Flow Bypass Conveyance and install stabilization measures as shown on the Plans. Temporarily direct all flow to the Flow Bypass Conveyance. When Level Spreader construction is complete and any associated vegetation is fully established, ensure the flow splitter or diversion box is in its permanent configuration and direct the design flow to the Level Spreader.

1.4.2.2 Vegetated Filter Area

Grade the Vegetated Filter Area (if required) to the design slope using a box blade or similar equipment. Avoid driving heavy equipment through the Vegetated Filter Area to prevent compaction. See Specification WQ-11 for Permanent Water Quality Stream Buffer Requirements and Specification WQ-12 for Vegetated Filter Strip requirements that may be applicable to the Vegetated Filter Area.

1.4.2.3 Excavation

Excavate the area for the Level Spreader Swale, Underdrain, and Level Spreader Lip as shown on the Plans. Remove excavated materials and dispose of them properly.

1.4.2.4 Level Spreader Lip

For all applications, install the Level Spreader Lip a minimum of 6 inches higher than the existing downstream ground and 1-foot wide in the direction of flow over the lip. Place and anchor a Class 2, Type C nonwoven geotextile on the downslope side of the Level Spreader Lip a minimum of 3 feet and place a 3 to 4-inch layer of #57 stone on top of the geotextile to minimize erosion. See Detail WQ-13B for further Level Spreader Lip installation guidance.

Commercial/Industrial Sites:

Install an appropriately sized concrete footer to stabilize the concrete Level Spreader Lip. Install a 1-foot wide cast in place concrete Level Spreader Lip at 0% grade. Ensure that the top of the forms are level.

Residential Sites:

The methods of construction will vary based on the materials chosen. Regardless of materials used, ensure the Level Spreader Lip is level across the entire length, meets minimum dimension requirements, and is anchored into the ground appropriately to prevent shifting or settlement.

1.4.2.5 Underdrains

Install an underdrain system that consists of continuous closed joint perforated plastic pipe underdrains with a minimum 4-inch diameter, an 8-inch minimum gravel filter layer, a non-woven geotextile filter fabric to wrap the perforated pipe and to separate the gravel from the native soils, and minimum 4-inch diameter non-perforated PVC clean out wells. At a minimum, clean out wells should be located at each upstream terminus of the underdrain to allow for underdrain flushing and maintenance. Ensure the underdrain discharges to the Flow Bypass Conveyance or other stable outlet as determined by site-specific design criteria.

1.4.2.6 Level Spreader Swale

The Level Spreader Swale is typically constructed from earth and stabilized with turfgrass Sod, TRM, concrete, or rip rap lining. Install the Level Spreader Swale with dimensions as shown on the design Plans and details. Tie the ends of the Level Spreader Swale into higher ground to prevent flow around the Level Spreader Lip.

Place fill soil in the excavated trench around the underdrain system to construct Level Spreader Swale (dimensions per Plans and details; for minimum dimensions see Section 1.2), and Sod or otherwise stabilize

the swale. Sod is required for stabilization of the Level Spreader Swale by vegetation, unless infeasible. In commercial or industrial applications, the Level Spreader Swale may be concrete.

1.4.2.7 Forebay

Construct a Forebay upstream of the Level Spreader Swale using a small excavator. Excavate the Forebay to the dimensions, side slopes, and elevations shown on the site Plans. The minimum depth of the Forebay ranges from 1 to 3 feet.

1.5 Inspection and Maintenance

Regular inspection and maintenance are critical to the effective operation of Level Spreaders. During the first year after construction, inspect Level Spreaders for proper distribution of flows and signs of erosion during and after all major rainfall events. After the first year, inspect Level Spreaders annually.

Summary of maintenance requirements:

- Maintain Level Spreaders annually and after all major storm events.
- Check the Level Spreader and downstream vegetated area for signs of erosion.
- Address erosion that is discovered in the vegetated area through the application of turf reinforcement matting (TRM) and through re-grading if necessary.
- Remove sediment and debris from the Forebay and from behind the Level Spreader Lip.
- Maintain the vegetation in the Forebay and around the Level Spreader to a height of approximately 3 to 6 inches.

Other required maintenance includes, but is not limited to:

- Mowing and trimming as needed.
- Replacing or replenishing vegetation and plants as needed.
- Removing trash and debris periodically as needed.
- Re-grading and re-seeding Level Spreader upslope edges and the forebay as a result of deposited sediment. (Depositing sediment may kill grass and change the Level Spreader elevation.)

1.6 IDEAL Modeling

The County's required method of demonstrating compliance with its water quality standards is to use the Greenville County IDEAL model. To facilitate use of this model, the following information describes how to represent this BMP in the IDEAL model. To model a Level Spreader treatment train system as described in the sections above in IDEAL, multiple BMPs may be modeled. The following are options to consider along with references to other applicable Specifications which provide further IDEAL guidance:

- If the forebay is large enough to significantly reduce pollutants, then it should be modeled as a Bioretention Cell according to the Specification WQ-05, but it can be ignored if it will not be large enough to provide significant pollutant trapping. Since the Bioretention Cell in IDEAL requires the use of a riser structure that would not be present as a part of a Level Spreader system, the riser height should be set to 99 feet to prevent it from being overtopped in model calculations.
- **The Level Spreader itself should be modeled as a Diffuse Channel in IDEAL.**
- The Diffuse Channel may discharge to a Vegetated Filter Strip (see Specification WQ-12) or a Permanent Water Quality Stream Buffer (see Specification WQ-11).

1.7 References

North Carolina DENR Stormwater BMP Manual, March 9, 2010.

North Carolina Division of Water Quality, Level Spreader Design Guidance, January 1, 2007.

Natural Resources Conservation Service, Conservation Practice Standard for Level Spreader, January 1999.