

A Guide to
Temporary Erosion-Control
Measures
for Contractors, Designers and Inspectors



June 2001

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Purpose and Use of This Manual

PURPOSE

Erosion control is mandatory on all construction projects. Phase II of the National Pollution Discharge Elimination System (NPDES) will require projects disturbing areas larger than one acre in size to apply for a stormwater discharge permit. These criteria will force smaller contractors who normally do not have to deal with temporary erosion control measures to install these devices. This manual is intended to give all contractors, designers and inspectors the tools needed to properly install, maintain and implement their Stormwater Pollution Prevention (SWPP) Plans. Proper use of Best Management Practices (BMPs) will protect the environment and save the user time and money lost to erosion damage.

USE

This manual will allow users to implement Temporary Erosion-Control Measures (TECMs). The manual also provides information about design, placement, material specification, inspection and maintenance, as well as several TECMs.



NDPDES Permits

In an effort to limit the pollution of our nation's many streams, rivers and lakes, congress directed the Environmental Protection Agency (EPA) to enact Section 402 of the Clean Water Act. Section 402 established the NPDES to regulate the discharge of pollutants from point sources. In 1990, the EPA published further regulations under the NPDES program that defined the term inches stormwater discharge associated with industrial activity inches to include stormwater discharges from construction activities that disturb five or more acres. Phase II of the NPDES permit process, signed in 1999, requires construction activity that disturbs one to five acres of land to obtain an NPDES permit. The permitting requirement begins 2003, or earlier if required by the permitting authority. The EPA granted the responsibility of administrating and enforcing NPDES permitting to the states and has approved the North Dakota Department of Health (NDDoH) to administer and enforce the NPDES process in North Dakota, where it is referred to as the North Dakota Pollution Discharge Elimination System (NDPDES).

An NDPDES permit authorizes the site owner or contractor to discharge stormwater runoff. To apply for a permit, a Notice of Intent (NOI) must be submitted along with a SWPP Plan. The authorization to discharge stormwater requires stormwater that contains sediment to remain on site. This means that the runoff must be detained onsite to allow sediment to settle or be filtered out.

The core of the stormwater permit process is the SWPP Plan, is a listing of all planned erosion and sediment control practices on site. The SWPP Plan also addresses inspection and maintenance procedures. The SWPP Plan must be kept on the project site along with the record of inspection forms.

Upon completion of the project and stabilization of the disturbed areas, the permittee files a Notice of Termination (NOT). The NOT signifies that the site is stabilized when vegetation has been established on 70 percent of the disturbed area and coverage under the NDPDES permit is no longer required.

Design Objectives

When developing a temporary erosion-control plan for a specific site, you must decide which of the following three design objectives is most suitable:

- **Keep the soil at its original location.**
- **Keep the soil close to its original location.**
- **Keep the soil on site.**

Keeping the soil at its original location is the preferred objective because it causes the least amount of harm to the environment. This option not only protects the surrounding land and water, but also prevents costly re-grading and redressing of slopes and ditches. However, keeping the soil at its original location is not always possible due to challenging topography and other site variables. If the soil can't be kept at its original location, it should be kept close. This option will require some re-grading and redressing of slopes and ditches. Finally, if site conditions are such that neither of the first two objectives can be met, at least try to keep the soil from leaving the site. Soil transported off-site can cause far-reaching damage to the downstream environment. Loss of soil from the site should be avoided to the Maximum Extent Practicable.



Selection Chart

The following table provides general guidance for the selection of the most appropriate temporary erosion-control measures. The table is generalized and does not represent every condition that may be encountered in the field. The selection of temporary erosion control measures for some situations must be based upon good judgment and past experience under similar conditions.

| <i>Area to Protect</i> | <i>Grade or Control Needed</i> | <i>BMP to Use</i> |
|------------------------------|--|-------------------------------|
| Ditches | Grade less than or equal to 6 percent? | Bale ditch check |
| | | Silt fence ditch check |
| | | TSD ditch check |
| | Grade greater than 6 percent? | Rock ditch check |
| | | Erosion-control blankets |
| | High flows expected? | Rock Ditch Check |
| | | Erosion Control Blankets |
| Slopes | Erosion-control | Temporary seeding |
| | | Erosion-control blankets |
| | Sediment control | Bale slope barriers |
| | | Silt fence slope barriers |
| Drop-Inlet Protection | (No decision needed) | Bale drop-inlet barrier |
| | | Silt fence drop-inlet barrier |
| | | TSD drop-inlet barrier |



Section 1 – Bale Ditch Checks

PURPOSE AND OPERATION

The purpose of bale ditch checks is to intercept runoff. The sediment-laden runoff will pond behind the bales, slowing the runoff velocity and allowing most of the suspended sediment to drop out. Water is intended to flow over the bales, not around the side. In ditches with high flows or steep slopes, erosion protection will be required on the downstream side of the bales. This can be accomplished by using erosion-control blanket or riprap.

DESIGN

Material Specifications

- Bale ditch checks may be constructed of wheat straw, oat straw, prairie hay or bromegrass hay that is free of weeds declared noxious by the North Dakota State Board of Agriculture.
- The stakes used to anchor the bales should be made of a hardwood material with the following minimum dimensions: 50 millimeters (2 inches x2 inches) square (nominal) by 1.2 meters (4.0 feet) long.
- Twine should be used to bind bales. The use of wire binding is prohibited because it does not biodegrade readily.
- **Optional:** The downstream scour apron should be constructed of a double-netted straw erosion-control blanket at least 1.8 meters (6.0 feet) wide.
- **Optional:** The metal landscape staples used to anchor the erosion-control blanket should be at least 200 millimeters (4 inches) long.

Placement

- Bale ditch checks should be placed **perpendicular** to the flowline of the ditch.
- The ditch check should extend far enough so that the ground level at the ends of the check is higher than the top of the lowest center bale. This prevents water from flowing around the check.
- Checks should not be placed in ditches where high flows are expected. Rock checks should be used instead.
- Bales should be placed in ditches with slopes of 6 percent or less. For slopes steeper than 6 percent, rock checks should be used.

The following table provides check spacing for a given ditch grade:

| <i>Ditch-Check Spacing</i> | | |
|----------------------------|----------------------------|------------------------------|
| Ditch Grade (percent) | Check Spacing (feet) | Check Spacing (meters) |
| 1.0 | 200 | 61 |
| 2.0 | 98 | 30 |
| 3.0 | 66 | 20 |
| 4.0 | 49 | 15 |
| 5.0 | 39 | 12 |
| 6.0 | 10 | 10 |
| >6.0 | Do not use bales. | |

INSTALLATION

Proper Installation Method

- Perpendicular to the ditch flowline, excavate a trench that is 150 millimeters (6 inches) deep and a bale's width wide. Extend the trench in a straight line along the entire length of the proposed ditch check. Place the soil on the upstream side of the trench to save for later use.
- **Optional:** On the downstream side of the trench, roll out a length of erosion-control blanket (scour apron) equal to the length of the trench. Place the upstream edge of the erosion-control blanket along the bottom upstream edge of the trench. The erosion-control blanket should be anchored in the trench with one row of 200-millimeter (8-inch) landscape staples placed on 460-millimeter (18-inch) centers. The remainder of the erosion-control blanket (the portion that is not lying in the trench) will serve as the downstream scour apron. This section of the blanket should be anchored to the ground with 200-millimeter landscape staples placed around the perimeter of the blanket on 460-millimeter (18-inch) centers. The remainder of the blanket should be anchored using two evenly spaced rows of 200-millimeter (8-inch) landscape staples on 460-millimeter (18-inch) centers placed perpendicular to the flowline of the ditch.
- Place the bales in the trench, making sure that they are butted tightly. Two stakes should be driven through each bale along the centerline of the ditch check, approximately 150 millimeters to 200 millimeters (6 inches to 8 inches) in from the bale ends. Stakes should be driven **at least** 460 millimeters (18 inches) into the ground.
- Once all the bales have been installed and anchored, place the excavated soil against the upstream side of the check and compact it. The compacted soil should be no more than 75 millimeters to 100 millimeters (3 inches to 4 inches) deep and should extend upstream no more than 600 millimeters (24 inches).

Figure 1-1 - Elevation View - Ditch Installation

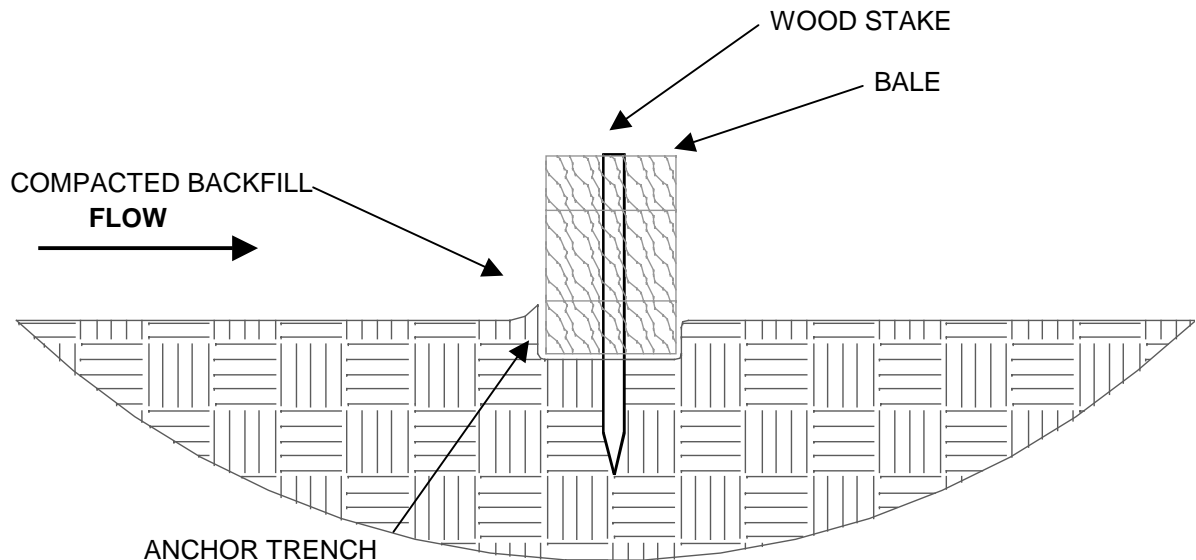
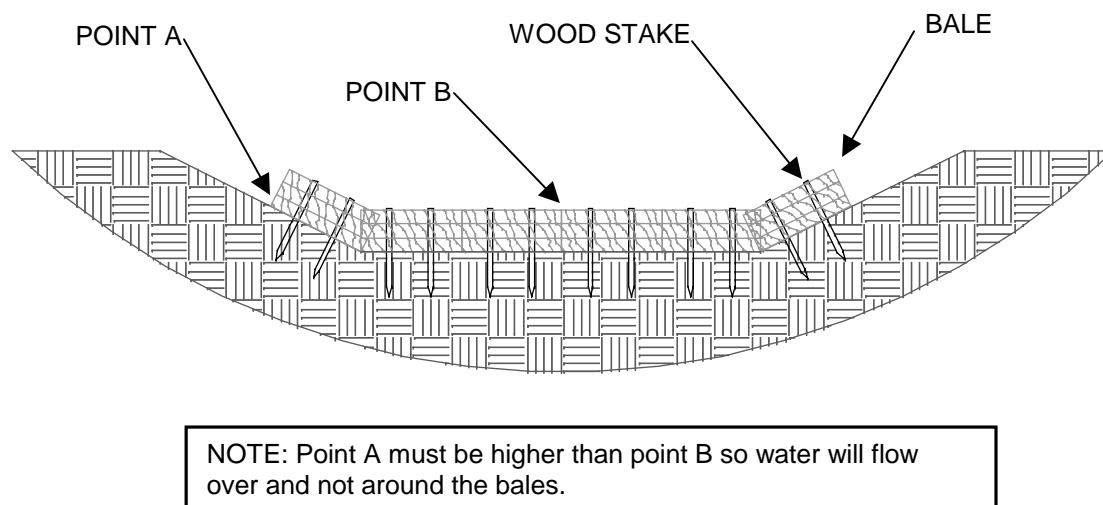


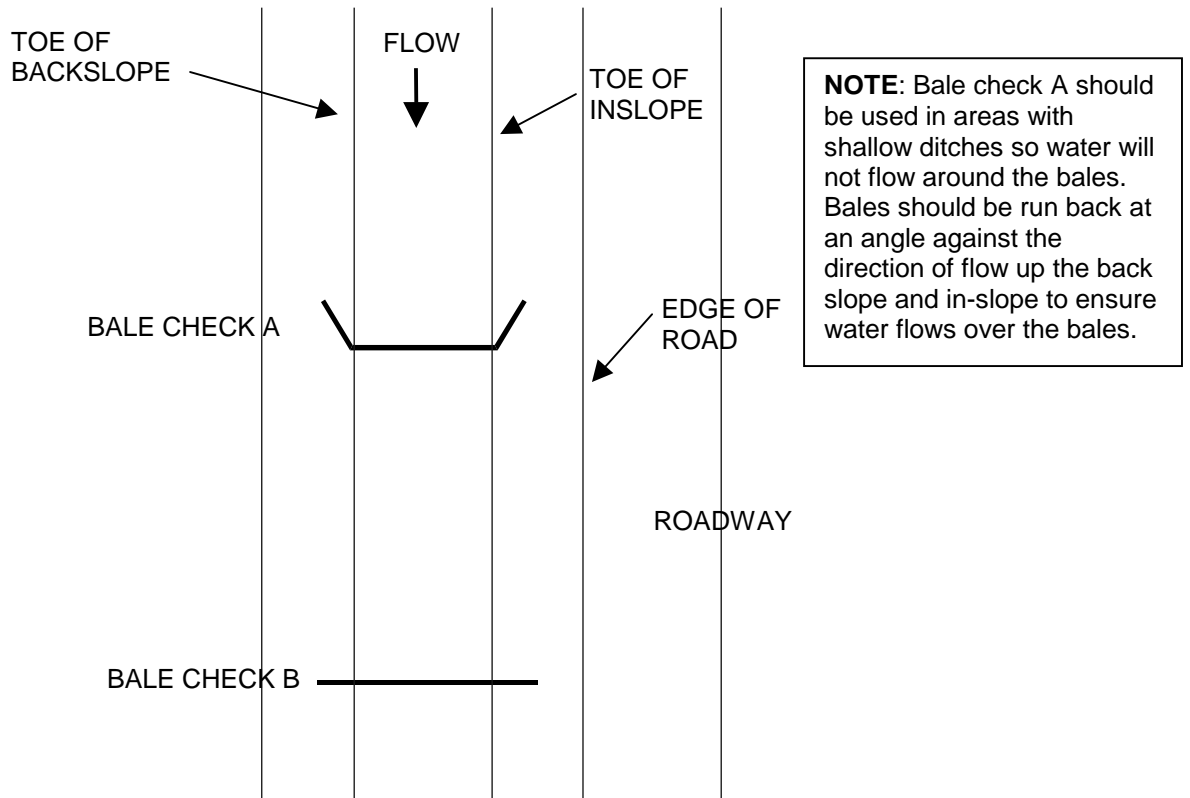
Figure 1-2 - Elevation View - Bale Check Installation



List of Common Placement/Installation Mistakes to Avoid

- Do not place a bale ditch check directly in front of a culvert outlet. It will not stand up to the concentrated flow.
- Do not place bale ditch checks in ditches that likely will experience high flows. They will not stand up to concentrated flow.
- Follow prescribed ditch-check spacing guidelines. If spacing guidelines are exceeded, erosion will occur between the ditch checks.
- Do not allow water to flow around the ditch check. Make sure that the ditch check is long enough so that the ground level at the ends of the check is higher than the top of the lowest center bale.
- Do not place bale ditch checks in channels with shallow soils underlain by rock. If the check is not anchored sufficiently, it will wash out.
- Bale ditch checks must be dug into the ground. Bales at ground level do not work because they allow water to flow under the check.

Figure 1-3 - Placement of Bale Checks



INSPECTION AND MAINTENANCE

Bale ditch checks should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (5 inches) or more. The following questions should be addressed during each inspection:

- **Does water flow around the ditch check?**
Water flowing around the ditch check usually is caused by insufficient ditch check length. If this occurs, extend the check far enough so that the ground level at the ends of the check is higher than the top of the lowest center bale.
- **Does water flow under the ditch check?**
Water flowing under the ditch check is caused by not trenching in the bales deep enough (at least 150 millimeters (6 inches)) or not sufficiently compaction of soil upstream of the check. If the problem is insufficient compaction, add more soil directly upstream of the check and re-compact. If the problem is improperly trenched bales, the entire check should be removed and a new one installed using the proper trench depth.
- **Does water flow through spaces between abutting bales?**
Water flowing between the bales usually is caused by not butting the bales tightly during initial installation. Stuffing loose bale material between the bales to fill up the space usually can solve this problem.

- **Are any bales and/or scour aprons (optional) dislodged?**
Check to see if any bales or scour aprons have become dislodged from their original position. Dislodged bales and scour aprons should be repositioned and re-staked if they are still usable; if not, replace them.
- **Are bales decomposing due to age and/or water damage?**
Under normal conditions, the maximum useful life of a bale is three months (but may be longer during prolonged dry periods). Inspect the bales for signs of decomposition and replace as necessary.
- **Does sediment need to be removed from behind the ditch check?**
Sediment accumulated behind the ditch check should be removed when it reaches one-half of the original exposed height of the bales. Allowing too much sediment to accumulate behind a ditch check drastically reduces its effectiveness because one high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the ditch check, it is extremely important to inspect ditch checks within 24 hours of a heavy rainfall.

Helpful Hint – When removing sediment from behind a bale ditch check with a bulldozer or backhoe, take care not to undermine the entrenched bales.



Section 2 – Silt Fence Ditch Checks

PURPOSE AND OPERATION

Silt fence ditch checks operate by intercepting, ponding and filtering sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle. As the ponded water percolates through the silt fence fabric, much of the remaining suspended sediment is filtered out. Silt fence ditch checks work well in ditches with low flows and moderate slopes.

DESIGN

Material Specifications

- Silt fence fabric should conform to the AASHTO M288 96 silt fence specification.
- The posts used to support the silt fence fabric should be a hardwood material with the following minimum dimensions: 50 millimeters (2 inches) square (nominal) by 1.2 meters (4 feet) long. **NOTE:** For structural stability metal posts should be used in areas that will pond water.
- Silt fence fabric should be attached to the wooden posts with staples, wire, zip ties or nails.

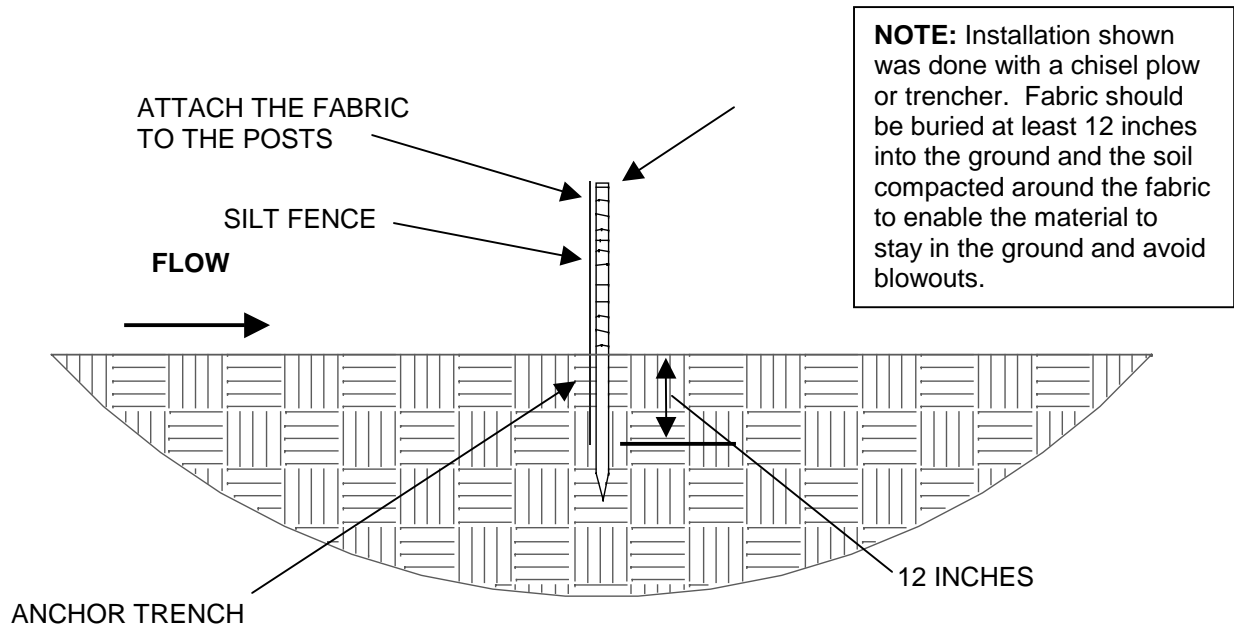
Placement

- Place silt fence in ditches where it is unlikely to be overtopped. Water should flow through a silt fence ditch check, **not over it**. Silt fence ditch checks often fail when overtopped.
- Silt fence ditch checks should be placed **perpendicular** to the flowline of the ditch.
- The silt fence should extend far enough so that the ground level at the ends of the fence is higher than the top of the low point of the fence. This prevents water from flowing around the check.
- Checks should not be placed in ditches where high flows are expected. Rock checks should be used instead.
- Silt fence should be placed in ditches with slopes of 6 percent or less. For slopes steeper than 6 percent, rock checks should be used.

The following table provides check spacing for a given ditch grade:

| <i>Ditch Check Spacing</i> | | |
|----------------------------|----------------------------|------------------------------|
| Ditch grade (percent) | Check Spacing (feet) | Check Spacing (meters) |
| <i>1.0</i> | 200 | 61 |
| <i>2.0</i> | 98 | 30 |
| <i>3.0</i> | 66 | 20 |
| <i>4.0</i> | 49 | 15 |
| <i>5.0</i> | 39 | 12 |
| <i>6.0</i> | 10 | 10 |
| <i>>6.0</i> | Do not use silt fence. | |

Figure 2-1 - Side view - Silt Fence Ditch Check.

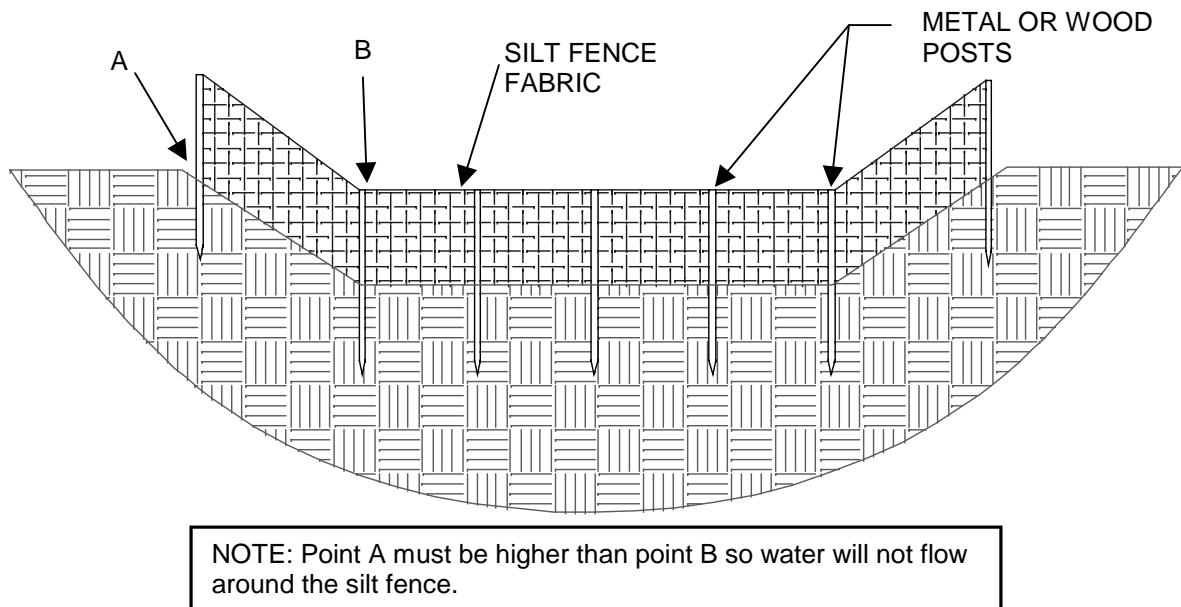


INSTALLATION

Proper Installation Method

- Perpendicular to the ditch flowline, excavate a trench that is **at least** 150 millimeters (6 inches) deep by 100 millimeters (4 inches) wide. Extend the trench in a straight line along the entire length of the proposed ditch check. Place the soil on the upstream side of the trench for later use. **Note:** Another common and less labor intensive installation method uses a trencher or chisel plow to install the silt fence. The silt fence will last longer and is less likely to blow out underneath.
- Roll out a continuous length of silt fence fabric on the downstream side of the trench. Place the edge of the fabric in the trench starting at the top upstream edge of the trench. Line all three sides of the trench with the fabric. Backfill over the fabric in the trench with the excavated soil, and compact. After filling the trench, approximately 600 millimeters to 900 millimeters (24 inches to 36 inches) of silt fence fabric should remain exposed.
- Lay the exposed silt fence on the upstream side of the trench to clear an area for driving in the posts. Just downstream of the trench, drive posts into the ground to a depth of at least 600 millimeters (24 inches). Place posts no more than 1.2 meters (4 feet) apart.
- Attach the silt fence to the anchored post with staples, wire, zip ties or nails.

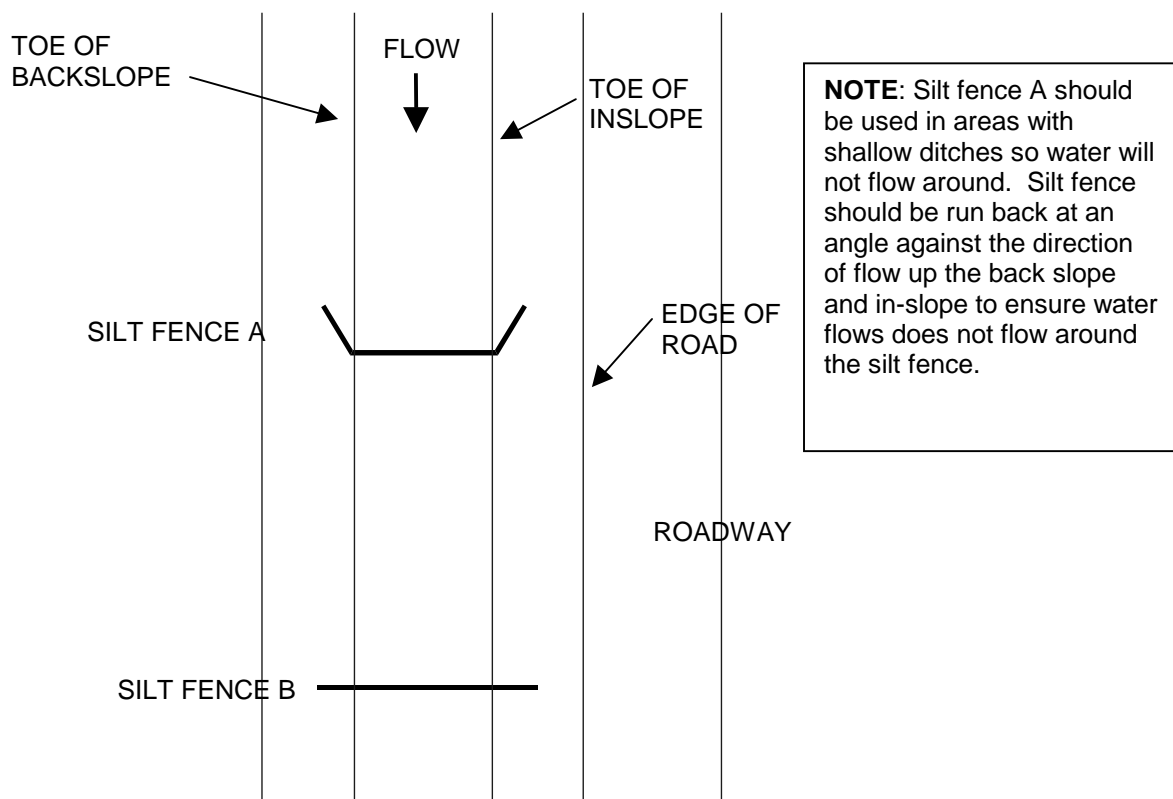
Figure 2-2 - Elevation view - Silt Fence Ditch Check



List of Common Placement/Installation Mistakes to Avoid

- Water should flow through a silt fence ditch check, not over it. Place silt fence in ditches where it is unlikely to be overtopped. Silt fence installations quickly deteriorate when water overtops them.
- Do not place silt fence posts on the upstream side of the silt fence fabric. In this configuration, the force of the water is not restricted by the posts, but only by the staples (wire, zip ties, nails, etc.). The silt fence will rip and fail.
- Do not place a silt fence ditch check directly in front of a culvert outlet. It will not stand up to the concentrated flow.
- Do not place silt fence ditch checks in ditches that likely will experience high flows. They will not stand up to concentrated flow.
- Follow prescribed ditch-check spacing guidelines. If spacing guidelines are exceeded, erosion will occur between the ditch checks.
- Do not allow water to flow around the ditch check. Make sure that the ditch check is long enough so that the ground level at the ends of the fence is higher than the low point on the top of the fence.
- Do not place silt fence ditch checks in channels with shallow soils underlain by rock. If the check is not anchored sufficiently, it will wash out.

Figure 2-3 - Placement of silt fence



INSPECTION AND MAINTENANCE

Silt fence ditch checks should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (5 inches) or more. The following questions should be addressed during each inspection:

- **Does water flow around the ditch check?**
Water flowing around the ditch check usually is caused by insufficient ditch check length. If this occurs, lengthen the check so that the ground level at the ends of the fence is higher than the low point on the **top** of the fence.
- **Does water flow under the ditch check?**
Water flowing under the ditch check can be caused by posts that are too far apart, a trench that is too shallow, or an improper burial procedure. Posts should be no more than 1.2 meters (4 feet) apart. The trench should be at least 100 millimeters (4 inches) wide by 150 millimeters (6 inches) deep. The bottom edge of the silt fence should be anchored securely by backfilling over the fabric in the trench with the excavated soil and then compacting. If these guidelines have not been met, the silt fence ditch check should be reinstalled or the deficiencies remedied.
- **Does the silt fence sag excessively?**
Sagging silt fence is caused by excessive post spacing and/or overtopping of the silt fence. Silt fence posts should be no more than 1.2 meters (4 feet) apart. If the post spacing exceeds 1.2 meters (4 feet); additional posts should be added to decrease spacing between posts. Water should flow through a silt fence ditch check, **not over it**. Silt fence installations deteriorate quickly when the water overtops them.

If a silt fence ditch check is regularly overtopped, it probably has been placed in a location that receives flows beyond its intended capacity. In this case, discontinue the use of silt fence in this area and try something different (e.g., bale ditch checks, TSDs, rock checks).

- **Has the silt fence torn or become detached from the posts?**
Silt fence can be torn by the force of ponded water or by winds that rip the silt fence fabric away from the posts. If a silt fence develops tears for any reason, it should be replaced.
- **Does sediment need to be removed from behind the ditch check?**
Sediment accumulated behind the ditch check should be removed when it reaches one-half of the original exposed height of the silt fence. Allowing too much sediment to accumulate behind a ditch check drastically reduces its effectiveness. Because one high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the ditch check, it is extremely important to inspect ditch checks within 24 hours of a heavy rainfall.

Helpful Hint – When removing sediment from behind a silt fence ditch check with a bulldozer or backhoe, take care not to undermine the entrenched silt fence.



Section 3 – Triangular Silt Dike™ Ditch Checks

PURPOSE AND OPERATION

Triangular Silt Dikes (TSDs) work on the same principle as bale ditch checks; they intercept and pond sediment-laden runoff. Ponding the water reduces the velocity of any incoming flow and allows most of the suspended sediment to settle. Water exits the TSD by flowing over the top. The geotextile apron on the downstream side of the dike helps prevent scour caused by this flowing water. Because TSD installations require a minimal depth for anchoring, they are well suited to ditches with shallow soils underlain by rock.

DESIGN

Material Specifications

- Triangular Silt Dikes™
- The metal landscape staples used to anchor the TSDs should be at least 150 millimeters to 200 millimeters (6 inches to 8 inches) long.

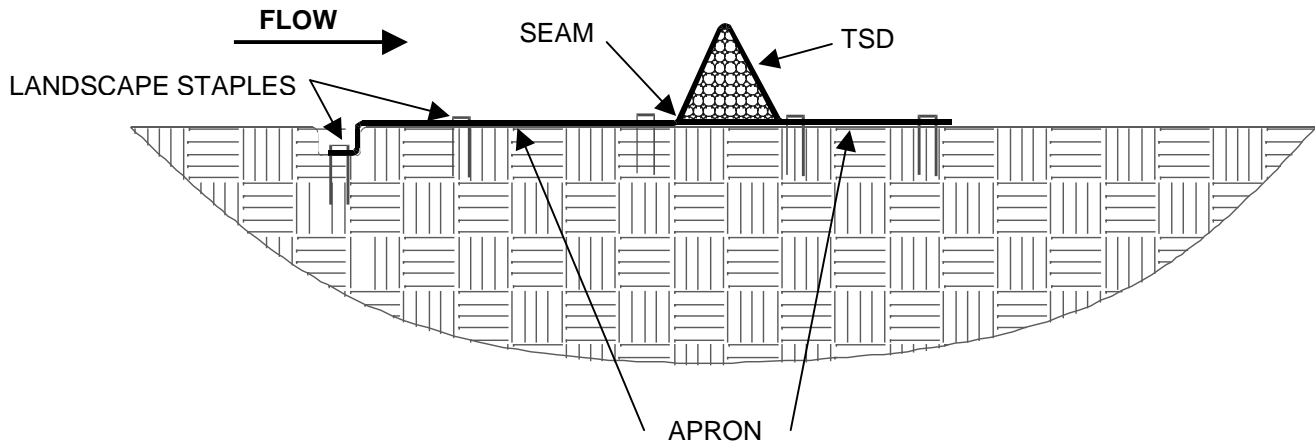
Placement

- TSDs should be placed **perpendicular** to the flowline of the ditch.
- The TSDs should extend far enough so that the bottoms of the end dikes are higher than the top of the lowest center dike. This prevents water from flowing around the TSD.
- TSDs should not be placed in ditches where high flows are expected. Rock checks should be used instead.
- TSDs should be placed in ditches with a slope of 6 percent or less. For slopes steeper than 6 percent, rock checks should be used.

The following table provides check spacing for a given ditch grade:

| <i>Ditch Check Spacing</i> | | |
|----------------------------|----------------------------|------------------------------|
| Ditch grade (percent) | Check Spacing (feet) | Check Spacing (meters) |
| 1.0 | 200 | 61 |
| 2.0 | 98 | 30 |
| 3.0 | 66 | 20 |
| 4.0 | 49 | 15 |
| 5.0 | 39 | 12 |
| 6.0 | 10 | 10 |
| >6.0 | Do not use TSDs. | |

Figure 3-1 - Side view - TSD

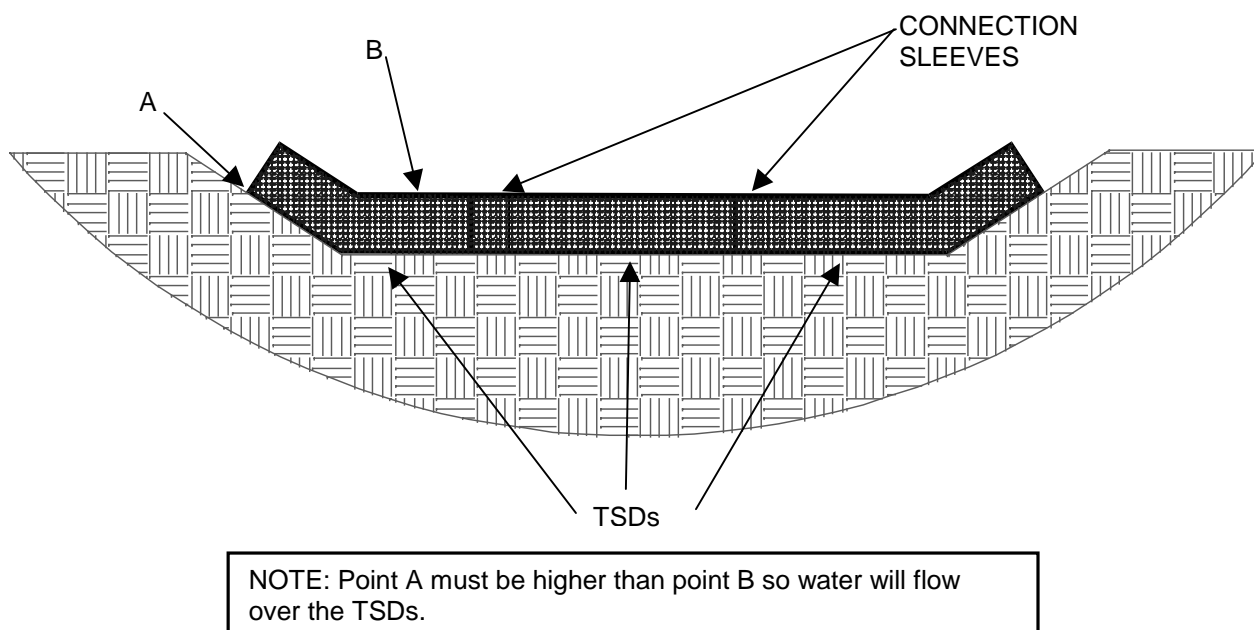


INSTALLATION

Proper Installation Method

- Perpendicular to the ditch flowline, excavate a trench that is at least 100 millimeters (4 inches) deep by 100 millimeters (4 inches) wide. Extend the trench in a straight line along the entire length of the proposed TSD installation. Place the soil on the upstream side of the trench for later use.
- Each TSD has two aprons: one upstream and one downstream. The upstream apron is the shorter of the two. Place one TSD on the downstream side of the trench. Conform the flexible TSD to the geometry of the ditch so that no space exists between the dike and the ditch bottom. Place the first 100 millimeters (4 inches) to 150 millimeters (6 inches) of the upstream apron into the trench and anchor it with one row of 150-millimeter to 200-millimeter (6 inch to 8 inch) landscape staples on 460-millimeter (18-inch) centers. Place an additional row of 150-millimeter to 200-millimeter (6-inch to 8-inch) landscape staples on 460-millimeter (18-inch) centers along the seam on the upstream side of the TSD. The downstream apron (which folds under the base of TSD) should terminate freely on the downstream side of the TSD. No trench is needed to anchor the downstream apron. This apron should be anchored with two rows of 150-millimeter to 200-millimeter (6-inch to 8-inch) landscape staples placed on 460-millimeter (18-inch) centers. One row should be placed where the downstream apron meets the base of the dike, and the other row should be placed at the downstream edge of the apron.
- Each TSD has an open sleeve at either end. Connect adjoining dikes with these sleeves and then **repeat the anchoring procedure in the previous step.**
- Once all the TSDs have been joined and anchored, fill in the upstream trench with soil and compact it.

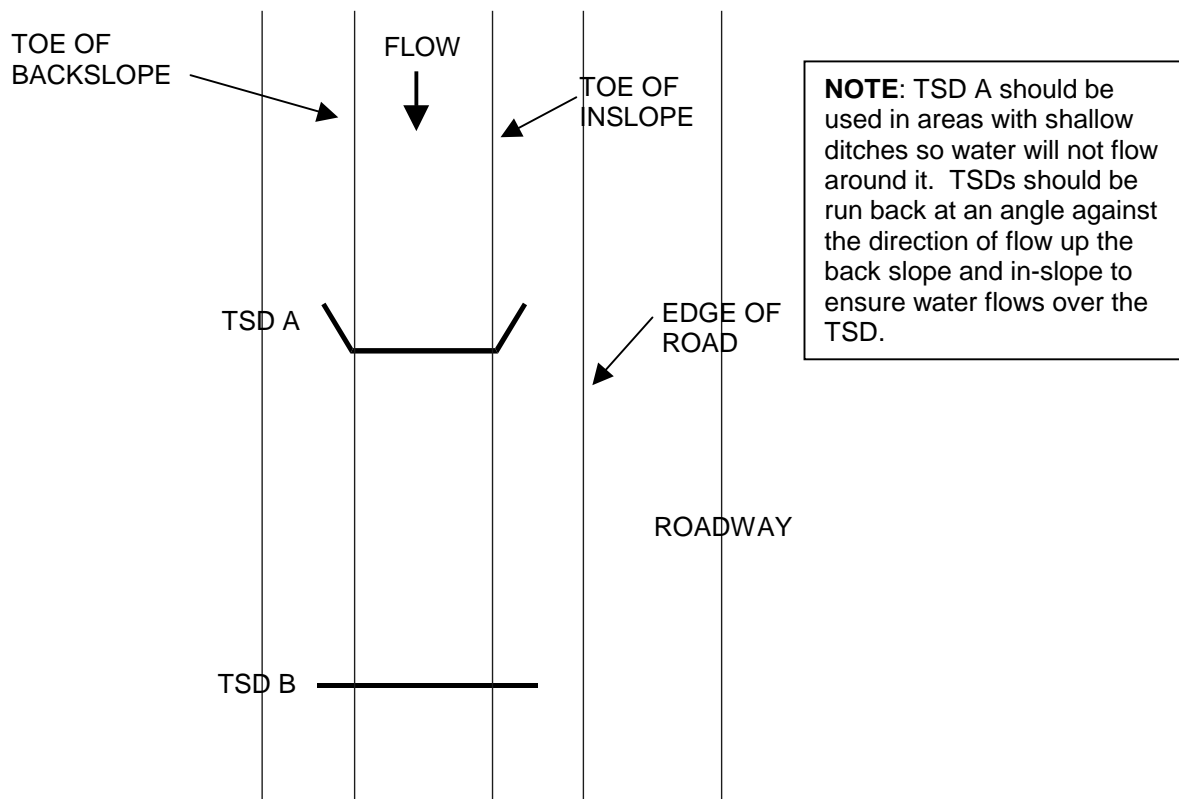
Figure 3-2 - Elevation view - TSD



List of Common Placement/Installation Mistakes to Avoid

- Do not place TSDs directly in front of a culvert outlet because they will not stand up to the concentrated flow.
- The upstream apron of the TSD must be dug into the soil and anchored or water will flow under the base of the check.
- Follow prescribed TSD spacing guidelines. If spacing guidelines are exceeded, erosion will occur between the ditch checks.
- Do not allow water to flow around the TSD. Make sure that the dike extends far enough so that the bottoms of the end dikes are higher than the top of the lowest center dike.

Figure 3-3 - Placement of TSD



INSPECTION AND MAINTENANCE

TSDs should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Does water flow around the TSDs?**
Water flowing around the TSDs usually is caused by insufficient dike length. If this occurs, extend the check to where the bottoms of the end dikes are higher than the top of the lowest center dike.
- **Does water flow under the TSDs?**
Water flowing under the TSDs usually is caused by not properly anchoring the TSD. Make sure that the upstream apron is trenched in and that an adequate number of staples have been used.
- **Does water flow through spaces between abutting TSDs?**
Water flowing between abutting TSDs usually is caused by poor connections between adjoining dikes. Connecting sleeves should connect the dikes at their ends. If spaces exist between adjoining dikes, they should be reconnected properly.
- **Does sediment need to be removed from behind the TSDs?**
Sediment accumulated behind the TSDs should be removed when it reaches one-half of the dike height. Allowing too much sediment to accumulate behind a TSD check drastically reduces its effectiveness. Because one high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the ditch check, it is extremely important to inspect ditch checks within 24 hours of a heavy rainfall.

Helpful Hint – When removing sediment from behind a TSD with a bulldozer or backhoe, make sure not to hook the upstream apron with the blade. This will damage the check, and it will have to be replaced.



Section 4 – Rock Ditch Checks

PURPOSE AND OPERATION

Rock ditch checks operate by intercepting and ponding sediment-laden runoff. Ponding the water dissipates the energy of any incoming flow and allows a large portion of the suspended sediment to settle. Water exits the ditch check by flowing over its crest. Rock ditch checks are ideal for ditches that eventually will have a riprap lining. Upon completion of the project, rock ditch checks can be spread out to form a riprap lined channel.

DESIGN

Material Specifications

Rock ditch checks should be constructed of stone that is between 100 millimeters to 200 millimeters (4 inches to 8 inches) in size. Field or quarry stone is acceptable; however, sand stone is not.

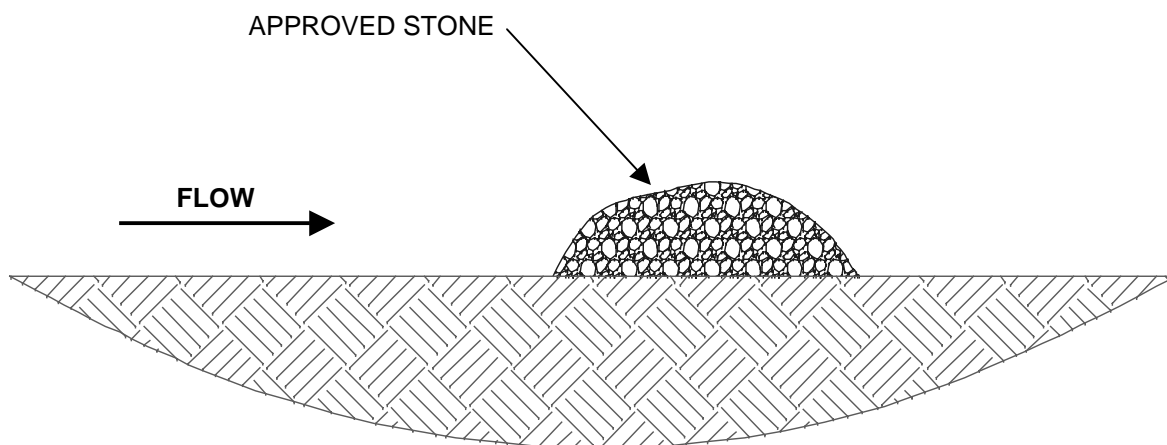
Placement

- Rock ditch checks should be **perpendicular** to the flowline of the ditch.
- Rock ditches must be designed so that water can flow over them, not around them. The ditch check should extend far enough so that the ground level at the ends of the check is higher than the low point on the crest of the check.
- Rock ditch checks are best located in ditches that eventually will be lined with riprap, so that the rock won't have to be removed at the completion of construction.

The following table provides check spacing for a given ditch grade:

| <i>Ditch Check Spacing</i> | | |
|----------------------------|----------------------------|------------------------------|
| Ditch grade (percent) | Check Spacing (feet) | Check Spacing (meters) |
| 5.0 | 59 | 18 |
| 6.0 | 49 | 15 |
| 7.0 | 43 | 13 |
| 8.0 | 36 | 11 |
| 9.0 | 33 | 10 |
| 10.0 | 30 | 9 |

Figure 4-1 - Side view - Rock Ditch Check

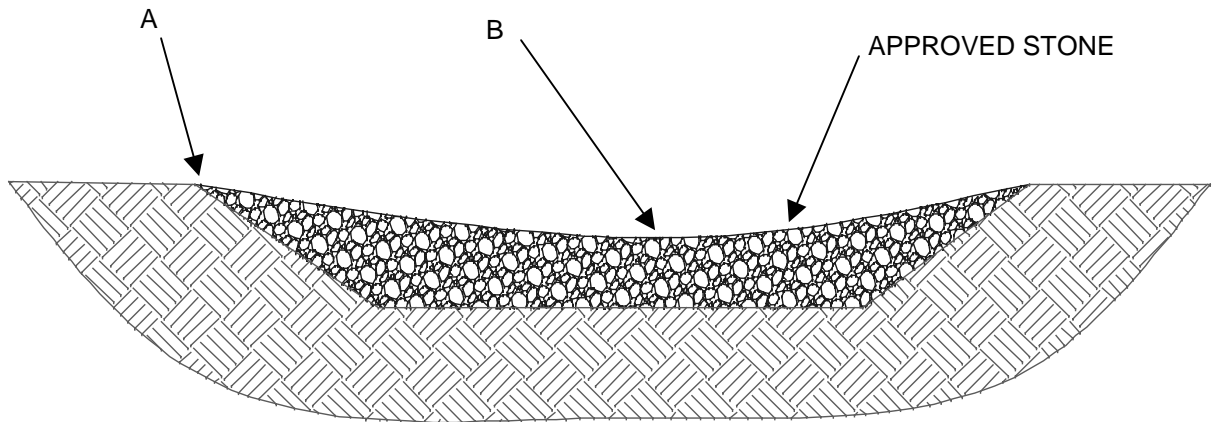


INSTALLATION

Proper Installation Method

- Using approved stone, construct a rock ditch check perpendicular to the ditch flowline. The ditch check should be 460 millimeters to 600 millimeters (18 inches to 24 inches) high and have side slopes no steeper than 1:1. The rock ditch check must be constructed so that water can **flow over the top**, not around the ends (i.e., the ground level at the ends of the check must be higher than the low point on the crest of the check).

Figure 4-2 - Elevation View - Rock Ditch Check

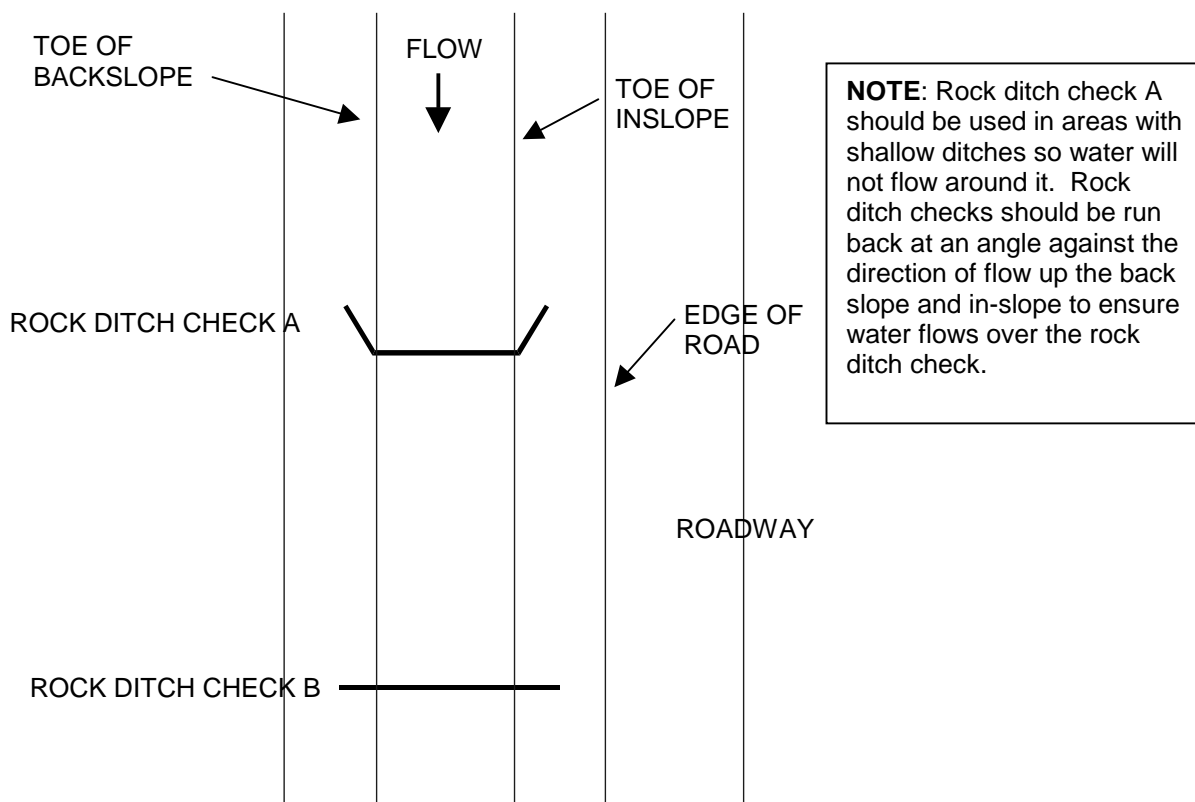


NOTE: Point A must be higher than point B so water will flow over the rock ditch check.

List of Common Placement/Installation Mistakes to Avoid

- Follow prescribed ditch check spacing guidelines. If spacing guidelines are exceeded, erosion will occur between the ditch checks.
- Do not allow water to flow around the ditch check. Make sure that the ditch check is long enough so that the ground level at the ends of the check is higher than the low point on the crest of the check.

Figure 4-3 - Placement of Rock Ditch Check



INSPECTION AND MAINTENANCE

Rock ditch checks should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Does water flow around the ditch check?**
Water flowing around the ditch check usually is caused by insufficient dike check length. If this occurs, extend the check a sufficient length so that the ground level at the ends of the check is higher than the low point on the crest of the check.
- **Have high-velocity flows displaced any stones from the check?**
Sometimes high-velocity flows can carry away portions of a rock ditch check. After a heavy rainstorm, inspect the rock ditch check for any displaced stones. If a large portion of a rock ditch check has washed away, fill in the void with new stone immediately.
- **Does sediment need to be removed from behind the ditch check?**
Sediment accumulated behind the ditch check should be removed when it reaches one-half of the original exposed height of the rock ditch check. Allowing too much sediment to accumulate behind a ditch check drastically reduces its effectiveness. Because one high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the ditch check, it is extremely important to inspect ditch checks within 24 hours of a heavy rainfall.

Helpful Hint – The easiest way to remove sediment from behind a rock ditch check is with a bulldozer or backhoe.

Section 5 – Bale Slope Barriers

PURPOSE AND OPERATION

Bale slope barriers operate by intercepting and ponding sediment-laden runoff. Ponding the water dissipates the energy of the incoming flow and allows much of the suspended sediment to settle. Water exits the bale slope barrier by flowing over the bales.

DESIGN

Material Specifications

- Bale slope barriers may be constructed of wheat straw, oat straw, prairie hay or bromegrass hay that is free of weeds declared noxious by the North Dakota State Board of Agriculture.
- The stakes used to anchor the bales should be a hardwood material with the following minimum dimensions: 50 millimeters (2 inches) square (nominal) by 1.2 meters (4 feet) long.
- Twine should be used to bind bales. The use of wire binding is prohibited because it does not biodegrade readily.

Placement

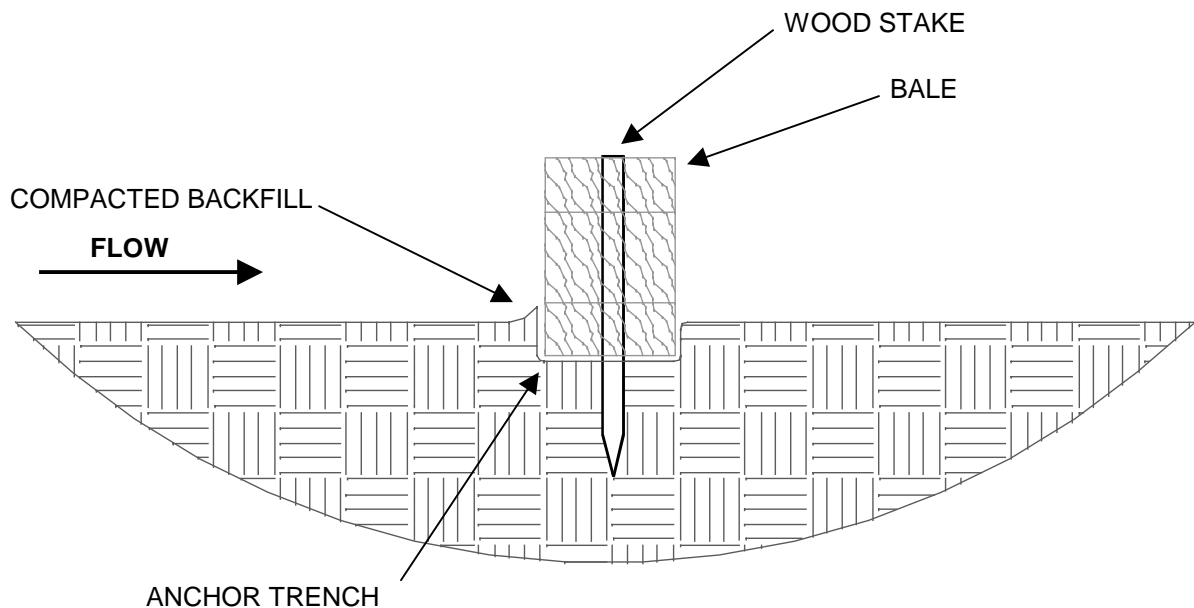
- A slope barrier should be used at the toe of a slope when a ditch does not exist. The slope barrier should be placed on nearly level ground 1.5 meters to 3.0 meters (5 feet to 10 feet) away from the toe of a slope. The barrier is placed away from the toe of the slope to provide adequate storage for settling sediment.
- When practicable, bale slope barriers should be placed along contours to avoid a concentration of flow.
- Bale slope barriers also can be placed along right-of-way fence lines to keep sediment from crossing onto adjacent property. When placed in this manner, the slope barrier will not likely follow contours.

INSTALLATION

Proper Installation Method

- Along the length of the planned slope barrier, excavate a trench that is 150 millimeters (6 inches) deep and a bale's width wide. Make sure that the trench is excavated along a single contour. **When practicable, slope barriers should be placed along contours to avoid a concentration of flow.** Place the soil on the upslope side of the trench for later use.
- Place the bales in the trench, making sure that they are butted tightly. Two stakes should be driven through each bale along the centerline of the ditch check, approximately 150 millimeters to 200 millimeters (6 inches to 8 inches) in from the bale ends. Stakes should be driven **at least** 460 millimeters (18 inches) into the ground.
- Once all the bales have been installed and anchored, place the excavated soil against the up-slope side of the check and compact it. The compacted soil should be no more than 75 millimeters to 100 millimeters (3 inches to 4 inches) deep.

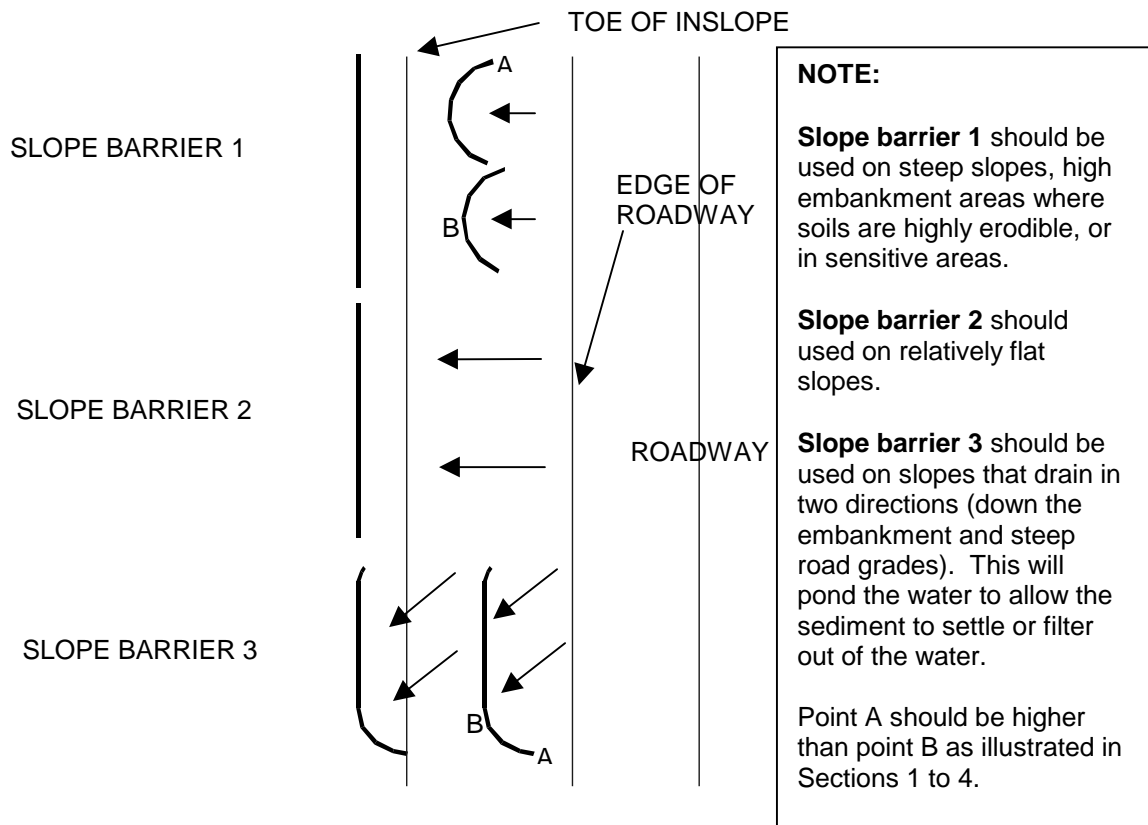
Figure 5-1 - Side View - Bale Slope Barrier



List of Common Placement/Installation Mistakes to Avoid

- When practicable, do not place bale slope barriers across contours. **Slope barriers should be placed along contours to avoid a concentration of flow.** Concentrated flow over a slope barrier creates a scour hole on the down-slope side of the barrier. The scour hole eventually undermines the bales and the barrier fails.
- Do not place bale slope barriers in areas with shallow soils underlain by rock. If the barrier is not anchored sufficiently, it will wash out.
- Bale slope barriers must be dug into the ground. Bales at ground level do not work because they allow water to flow under the barrier.

Figure 5-2 - Placement Bale Slope Barriers



INSPECTION AND MAINTENANCE

Bale slope barriers should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- Are there any points along the slope barrier where water is concentrating?**
 When slope barriers are not placed along contours, water concentrates at low points of the slope barrier. This concentrated flow usually causes a failure of the slope barrier. Even if the barrier does not fail, the concentration of flow drastically reduces the overall storage barrier (or sections of it) so that it becomes level.
- Does water flow under the slope barrier?**
 Water flowing under the barrier usually is caused by not trenching the bales deep enough (at least 150 millimeters (6 inches)) or by insufficient compaction of soil against the up-slope side of the check. If the problem is insufficient compaction, add more soil to the up-slope side of the check and recompact. If the problem is improperly trenched bales, the entire slope barrier should be removed and a new one installed using the proper trench depth.

- **Does water flow through spaces between abutting bales?**
Water flowing between bales usually is caused by not butting the bales tightly during initial installation. Stuffing loose bale material between the bales to fill up the space usually can solve this problem.
- **Are any bales dislodged?**
Under normal conditions, the maximum useful life of a bale is three months (but may be longer during prolonged dry periods). Inspect the bales for signs of decomposition and replace as necessary.
- **Does sediment need to be removed from behind the slope barrier?**
Sediment accumulated behind the slope barrier should be removed when it reaches one-half of the original exposed height of the bales. Allowing too much sediment to accumulate behind a slope barrier drastically reduces its effectiveness. Because one high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill up the space behind the slope barrier, it is extremely important to inspect slope barriers within 24 hours of a heavy rainfall.

Helpful Hint – When removing sediment from behind a bale slope barrier with a bulldozer or backhoe, take care not to undermine the entrenched bales.



Section 6 – Silt Fence Slope Barriers

PURPOSE AND OPERATION

Silt fence slope barriers operate by intercepting and ponding sediment-laden slope runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle. Water exits the silt fence slope barrier by percolating through the silt fence.

DESIGN

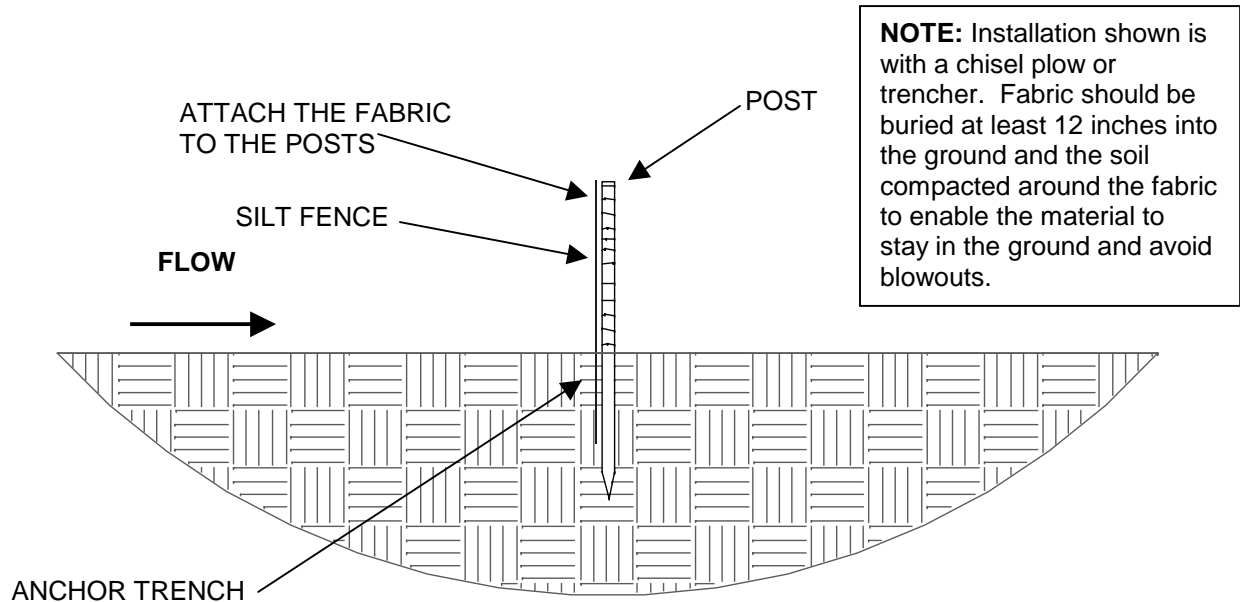
Material Specification

- Silt fence fabric should conform to the AASHTO M288 96 silt fence specification.
- The posts used to support the silt fence fabric should be a hardwood material with the following minimum dimensions: 50 millimeters (2 inches) square (nominal) by 1.2 meters (4 feet) long. **Note:** For structural stability metal posts should be used in areas where water will pond.
- Silt fence fabric should be attached to the wooden posts with staples, wire, zip ties or nails.

Placement

- A slope barrier should be used at the toe of a slope when a ditch does not exist. The slope barrier should be placed on nearly level ground 1.5 meters to 3.0 meters (5 feet to 10 feet) away from the toe of a slope to provide adequate storage for settling sediment.
- When practicable, silt fence slope barriers should be placed along contours to avoid concentrated flows.
- Silt fence slope barriers also can be placed along right-of-way fence lines to keep sediment from crossing onto adjacent property. When placed in this manner, the slope barrier will not likely follow contours.

Figure 6-1 - Side view - Silt Fence Slope Barrier

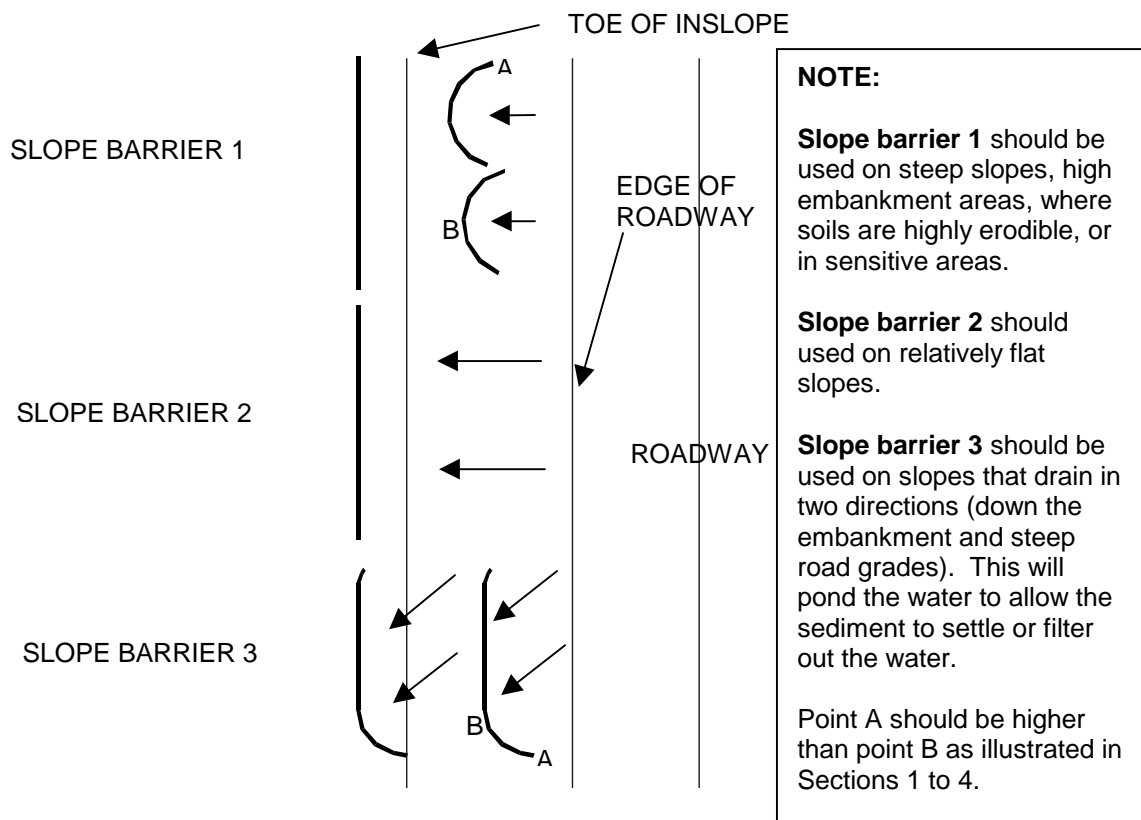


INSTALLATION

Proper Installation Method

- Along the length of the planned slope barrier excavate a trench that is 150 millimeters (6 inches) deep by 100 millimeters (4 inches) wide. Make sure that the trench is excavated along a single contour. **When practicable, slope barriers should be placed along contours to avoid a concentration of flow.** Place the soil on the up-slope side of the trench for later use. **Note:** Using a trencher or chisel plow to install the silt fence is less labor intensive. The silt fence will last longer and is less likely to blow out underneath.
- Roll out a continuous length of silt fence fabric on the down-slope side of the trench. Place the edge of the fabric in the trench starting at the top up-slope edge. Line all three sides of the trench with the fabric. Backfill over the fabric in the trench with the excavated soil, and compact. After filling the trench, drive posts into the ground to a depth of at least 600 millimeters (24 inches). Place posts no more than 1.2 meters (4 feet) apart.
- Attach the silt fence to the anchored post with staples, wire, zip ties or nails.

Figure 6-2 - Placement of Silt Fence Slope Barrier



List of Common Placement/Installation Mistakes to Avoid

- When practicable, do not place silt fence slope barriers across contours. **Slope barriers should be placed along contours to avoid concentration of flow.** When the flow concentrates, it overtops the barrier, and the silt fence slope barrier quickly deteriorates.
- Do not place silt fence posts on the up-slope side of the silt fence fabric. In this configuration, the force of the water is not restricted by the posts, but only by the staples (wire, zip ties, nails, etc.). The silt fence will rip and fail.
- Do not place silt fence slope barriers in areas with shallow soils underlain by rock. If the barrier is not sufficiently anchored, it will wash out.
- Silt fence slope barriers must be dug into the ground; silt fence at ground level does not work because water will flow underneath.

INSPECTION AND MAINTENANCE

Silt fence slope barriers should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Are there any points along the slope barrier where water is concentrating?**
When slope barriers are not placed along contours, water concentrates at low points of the slope barrier. This concentrated flow usually causes a failure of the slope barrier. Even if the barrier does not fail, the

concentration of flow drastically reduces the overall storage capacity of the slope barrier. The only solution to this problem is reinstalling the slope barrier (or sections of it) so that it is level.

- **Does water flow under the slope barrier?**

Water flowing under the slope barrier can be caused by posts that are too far apart, a trench that is too shallow, or an improper backfill procedure. Posts should be no more than 1.2 meters (4 feet) apart. The trench should be at least 100 millimeters (4 inches) wide by 150 millimeters (6 inches) deep. The bottom edge of the silt fence should be anchored securely by backfilling over the fabric in the trench with the excavated soil and then compacting. If these guidelines have not been met, the silt fence slope barrier should be reinstalled, or the deficiencies should be remedied.

- **Does the silt fence sag excessively?**

Sagging silt fence is caused by excessive post spacing and/or overtopping of the silt fence. Silt fence posts should be no more than 1.2 meters (4 feet) apart. If the post spacing exceeds 1.2 meters (4 feet), additional posts should be added to decrease spacing between posts. Water should flow through a silt fence slope barrier, not over it. Silt fence installations quickly deteriorate when water overtops them. If a silt fence slope barrier is regularly overtopped, it has probably been placed in a location that receives flows beyond intended capacity. If this is the case, discontinue the use of silt fence in this area and try something different (e.g., bale slope barrier).

- **Has the silt fence torn or become detached from the posts?**

Silt fence can be torn by the force of ponded water, or by winds that rip the silt fence fabric away from the posts. If a silt fence develops tears for any reason, it should be replaced.

- **Does sediment need to be removed from behind the slope barrier?**

Sediment accumulated behind the slope barrier should be removed when it reaches one-half of the original exposed height of the silt fence. Allowing too much sediment to accumulate behind a slope barrier drastically reduces its effectiveness. Because one high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill up the space behind the slope barrier, it is extremely important to inspect slope barriers within 24 hours of a heavy rainfall.

Helpful Hint – When removing sediment from behind a silt fence slope barrier with a bulldozer or backhoe, take care not to undermine the entrenched silt fence.



Section 7 – Bale Drop-Inlet Barriers

PURPOSE AND OPERATION

Bale drop-inlet barriers operate by intercepting and ponding sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle. When the pond height reaches the top of the barrier, water flows over the bales and into the drop inlet.

DESIGN

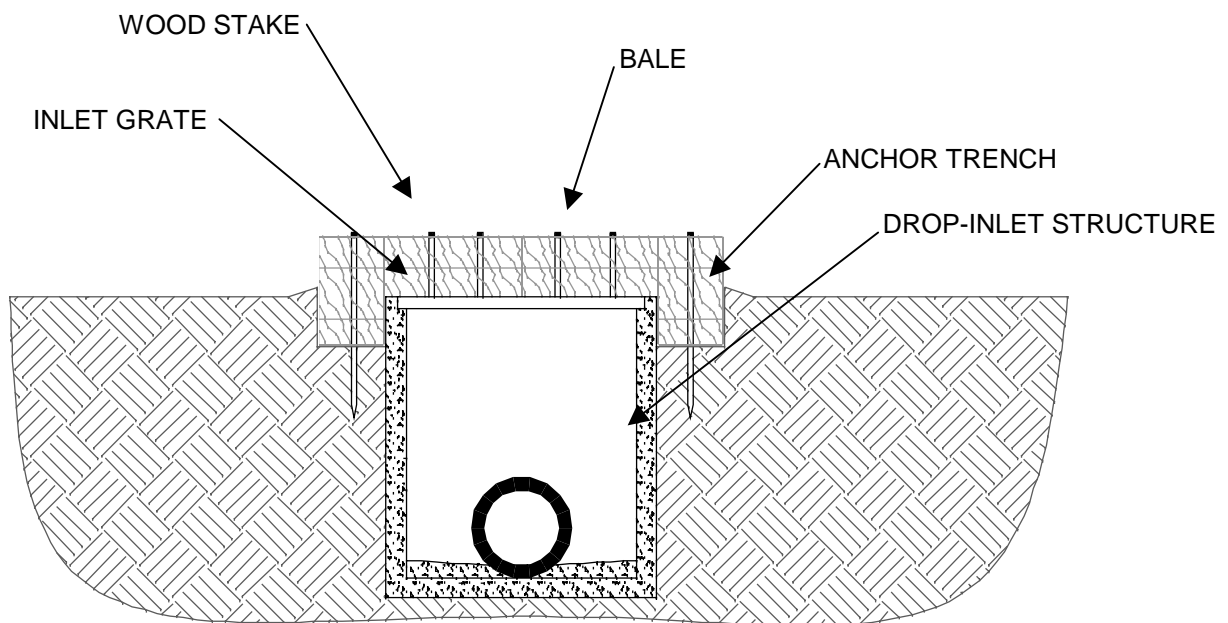
Material Specifications

- Bale drop-inlet barriers should be constructed of wheat straw, oat straw, prairie hay or bromegrass hay that is free of weeds declared noxious by the North Dakota State Board of Agriculture.
- The stakes used to anchor the bales should be a hardwood material with the following minimum dimensions: 50 millimeters (2 inches) square (nominal) by 1.2 meters (4 feet) long.
- Twine should be used to bind bales. The use of wire binding is prohibited because it does not biodegrade readily.

Placement

- Bale drop-inlet barriers should be placed directly around the perimeter of a drop inlet.
- When a bale drop-inlet barrier is located near an inlet that has steep approach slopes, the storage capacity behind the barrier is drastically reduced. Timely removal of sediment must occur for a barrier to operate properly in this location.

Figure 7-1 - Side View - Bale Drop-Inlet Barriers

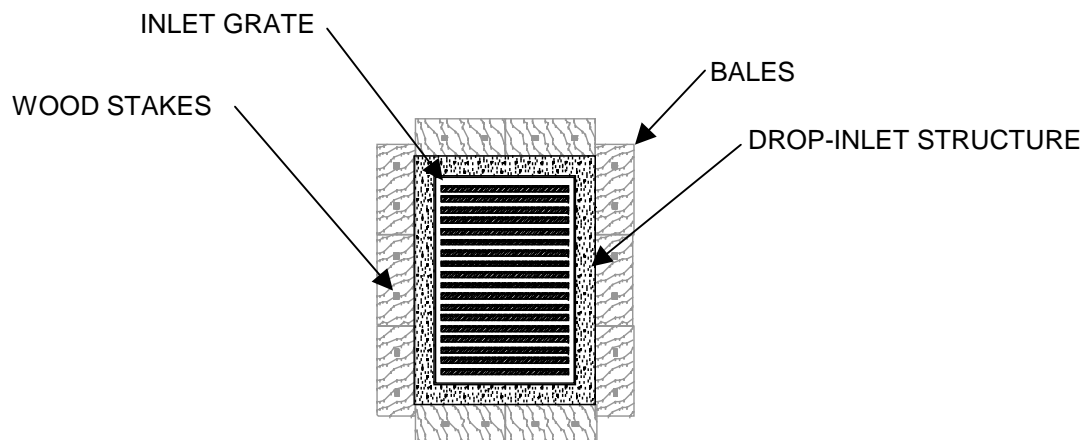


INSTALLATION

Proper Installation Method

- Around the perimeter of the drop inlet, excavate a trench that is at least 150 millimeters (6 inches) deep by a bale's width wide.
- Place the bales into the trench, making sure that they are butted tightly. Some bales may need to be shortened to fit into the trench around the drop inlet. Two stakes should be driven through each bale, approximately 150 millimeters to 200 millimeters (6 inches to 8 inches) from the bale ends. Stakes should be driven **at least** 460 millimeters (18 inches) into the ground.
- Once all the bales have been installed and anchored, place the excavated soil against the receiving side of the barrier and compact it. The compacted soil should be no more than 75 millimeters to 100 millimeters (3 inches to 4 inches) deep.
- Note: When a bale drop-inlet barrier is placed in a shallow median ditch, make sure that the top of the barrier is not higher than the paved road. In this configuration, water may spread onto the roadway causing a hazardous condition.

Figure 7-2 - Plan View - Bale Drop-Inlet Barriers



List of Common Placement/Installation Mistakes to Avoid

- Bales should be placed directly against the perimeter of the drop inlet. This allows overtopping water to flow directly into the inlet instead of onto nearby soil causing a scour hole to appear.
- Bale drop-inlet barriers must be dug into the ground. Bales at ground level do not work because they allow water to flow under the barrier.

INSPECTION AND MAINTENANCE

Bale drop-inlet barriers should be inspected every seven days and within 24 hours of a rainfall 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Does water flow under the drop-inlet barrier?**

Water flowing under the barrier usually is caused by not trenching the bales deep enough (at least 150 millimeters(6 inches)) or not compacting the soil around the barrier. If the problem is insufficient compaction, add more soil around the base of the barrier and re-compact. If the problem is improperly trenched bales, the drop-inlet barrier should be removed and a new one installed using the proper trench depth.

- **Does water flow through spaces between abutting bales?**

Water flowing between bales usually is caused by not butting the bales tightly during initial installation. Stuffing loose bale material between the bales to fill up the space usually can solve this problem.

- **Are any bales dislodged?**

Check to see if any bale has become dislodged from their original position. Dislodged bales should be repositioned and re-staked if they are still reusable; otherwise, replace them.

A dislodged bale should be repaired immediately because it has the potential to create a bigger problem: **flooding**. If a bale falls over onto a drop inlet during a storm, the inlet can become blocked, causing flooding of the roadway.

- **Are bales decomposing due to age and/or water damage?**

Under normal conditions, the maximum useful life of a bale is three months (but may be longer during prolonged dry periods). Inspect the bales for signs of decomposition and replace as necessary.

- **Does sediment need to be removed from behind the drop-inlet barrier?**

Sediment accumulated behind the drop-inlet barrier should be removed when it reaches one-half of the original exposed height of the bales. Allowing too much sediment to accumulate behind a drop-inlet barrier drastically reduces its effectiveness. Because one high-intensity rainfall can dislodge enough sediment from the drainage basin to completely fill the space behind the drop-inlet barrier, it is extremely important to inspect drop-inlet barriers within 24 hours of a heavy rainfall.

Helpful Hint – When removing sediment from behind a bale drop-inlet barrier with a bulldozer or backhoe, take care not to undermine the entrenched bales.



Section 8 – Silt Fence Drop-Inlet Barriers

PURPOSE AND OPERATION

Silt fence drop-inlet barriers work just like ditch checks or a slope barriers: the silt fence intercepts, ponds and filters sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle. As the ponded water percolates through the silt fence fabric, much of the remaining suspended sediment is filtered out.

DESIGN

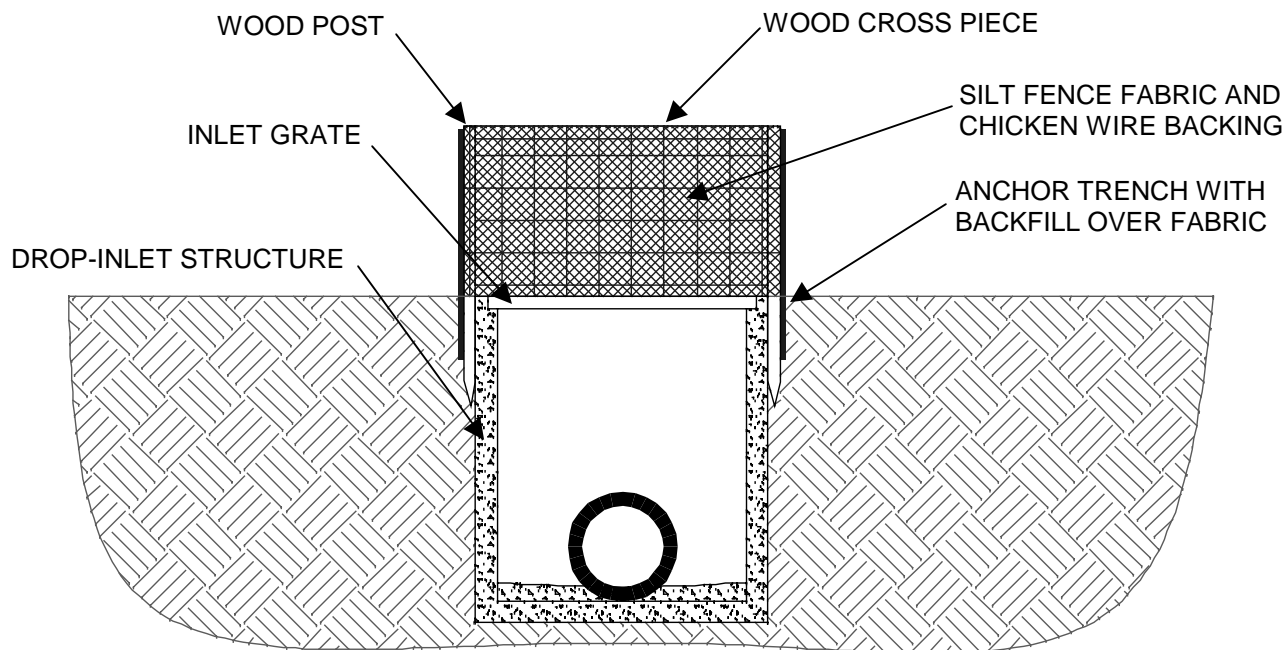
Material Specifications

- Silt fence fabric should conform to the AASHTO M288 96 silt fence specification.
- The wire or polymeric mesh backing used to help support the silt fence fabric should conform to the AASHTO M288 96 silt fence specification.
- The posts used to support the silt fence fabric should be a hardwood material with the following minimum dimensions: 50 millimeters (2 inches) square (nominal) by 1.2 meters (4 feet) long.
- The material used to frame the tops of the posts should be 50-millimeter by 100-millimeter (2-inch x 4-inch) boards.
- Silt fence fabric and support backing should be attached to the wooden posts and frame with staples, wire, zip ties or nails.

Placement

- Place a silt fence drop-inlet barrier in a location where it is unlikely to be overtopped. Water should flow through silt fence, not over it. Silt fence drop-inlet barriers often fail when repeatedly overtopped.
- When used as a drop-inlet barrier, silt fence fabric and posts must be supported at the top by a wooden frame.
- When a silt fence drop-inlet barrier is located near an inlet that has steep approach slopes, the storage capacity behind the barrier is drastically reduced. Timely removal of sediment must occur for a barrier to operate properly in this location.

Figure 8-1 - Side View - Silt Fence Drop Inlet Barriers

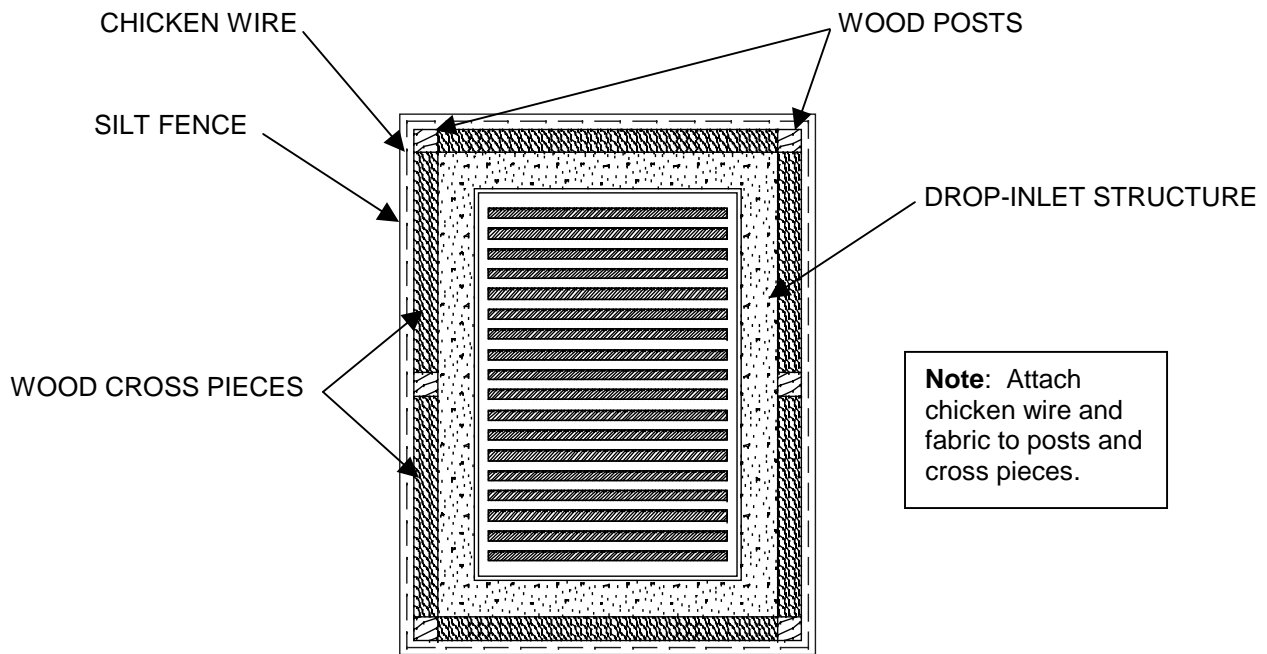


INSTALLATION

Proper Installation Method

- Around the perimeter of the drop inlet, excavate a trench that is **at least** 150 millimeters (6 inches) deep by 100 millimeters (4 inches) wide.
- Drive posts to a depth of at least 600 millimeters (24 inches) around the perimeter of the drop inlet. The distance between posts should be 1.2 meters (4 feet) or less. If the distance between two adjacent corner posts is more than 1.2 meters (4 feet), add another post(s) between them.
- Connect the tops of all the posts with a wooden frame made of 50-millimeter by 100-millimeter (2-inch x 4-inch) boards. Use nails or screws for fastening.
- Attach the wire or polymeric-mesh backing to the **outside** of the post/frame structure with staples, wire, zip ties or nails.
- Roll out a continuous length of silt-fence fabric long enough to wrap around the perimeter of the drop inlet. Add more length for overlapping the fabric joint. Place the edge of the fabric in the trench, starting at the outside edge of the trench. Line all three sides of the trench with the fabric. Backfill over the fabric in the trench with the excavated soil and compact. After filling the trench, about 600 millimeters to 900 millimeters (24 inches to 36 inches) of silt fence fabric should remain exposed.
- Attach the silt fence to the **outside** of the post/frame structure with staples, wire, zip ties or nails. The joint should be overlapped to the next post.
- **Note:** When a silt fence drop-inlet barrier is placed in a shallow median ditch, make sure that the top of the barrier is not higher than the paved road. In this configuration, water may spread onto the roadway causing a hazardous condition.

Figure 8-2 - Plan View - Silt Fence Drop-Inlet Barriers



List of Common Placement/Installation Mistakes to Avoid

- Water should flow through a silt fence drop-inlet barrier, not over it. Place a silt fence drop-inlet barrier in a location where it is unlikely to be overtopped. Silt fence drop-inlet barriers often fail when repeatedly overtopped.
- Do not place posts on the outside of the silt fence drop-inlet barrier. In this configuration, the force of the water is not resisted by the posts, but only by the staples (wire, zip-ties, nails, etc.). The silt fence will rip and fail.
- Do not install silt fence drop-inlet barriers without framing the top of the posts. The corner posts around drop inlets are stressed in two directions, whereas a normal silt fence is stressed in only one direction. This added stress requires more support.

INSPECTION AND MAINTENANCE

Silt fence drop-inlet barriers should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Does water flow under the silt fence?**
Water flowing under the silt fence can be caused by posts that are too far apart, a trench that is too shallow or an improper backfill procedure. Posts should be no more than 1.2 meters (4 feet) apart. The trench should be at least 100 millimeters (4 inches) wide by 150 millimeters (6 inches) deep. The bottom edge of the silt fence should be anchored securely by backfilling over the fabric in the trench with the

excavated soil and then compacting. If these guidelines have not been met, the silt fence drop-inlet barrier should be reinstalled, or the deficiencies should be remedied.

- **Does the silt fence sag excessively?**

Sagging silt fence is caused by excessive post spacing or the lack of a frame connecting the posts. Silt fence posts should be no more than 1.2 meters (4 feet) apart. If the post spacing exceeds 1.2 meters (4 feet), additional posts should be added to decrease spacing between posts. If no post frame exists, one should be added.

A sagging silt fence should be repaired immediately because it has the potential to create a bigger problem: **flooding**. If a silt fence falls over onto a drop inlet during a storm, the inlet can become blocked, causing flooding of the roadway.

- **Has the silt fence torn or become detached from the posts?**

Silt fence can be torn by the force of ponded water or by winds that rip the silt fence fabric away from the posts. If a silt fence develops tears for any reason, it should be replaced.

- **Does sediment need to be removed from behind the drop-inlet barrier?**

Sediment accumulated behind the drop-inlet barrier should be removed when it reaches one-half of the original exposed height of the silt fence. Allowing too much sediment to accumulate behind a drop-inlet barrier drastically reduces its effectiveness. Because one high-intensity rainfall can dislodge enough sediment from the drainage basin to completely fill the space behind the drop-inlet barrier. This is why it is extremely important to inspect drop-inlet barriers within 24 hours of a heavy rainfall.

Helpful Hint - When removing sediment from behind a silt fence drop-inlet barrier with a bulldozer or backhoe, take care not to undermine the entrenched silt fence.



Section 9 – TSD™ Drop-Inlet Barriers

PURPOSE AND OPERATION

Triangular Silt Dike (TSD) drop-inlet barriers operate by intercepting and ponding sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle. When the pond height reached the top of the barrier, water flows over the TSDs and into the drop inlet.

DESIGN

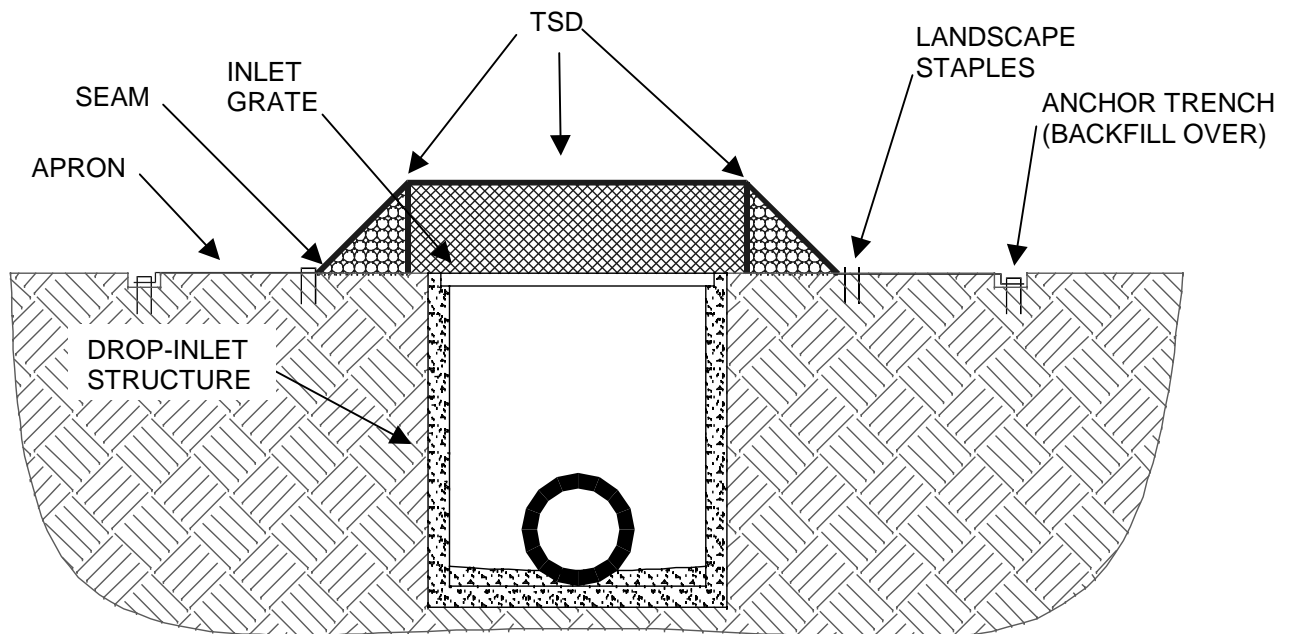
Material Specification

- Triangular Silt Dikes™
- The metal landscape staples used to anchor the TSDs should be at least 150 millimeters to 200 millimeters (6 inches to 8 inches) long.

Placement

- TSD drop-inlet barriers should be placed directly around the perimeter of a drop inlet.
- When a TSD drop-inlet barrier is located near an inlet that has steep approach slopes, the storage capacity behind the barrier is drastically reduced. Timely removal of sediment must occur for a barrier to operate properly in this location.

Figure 9-1 - Side View - TSD™ Drop-Inlet Barriers



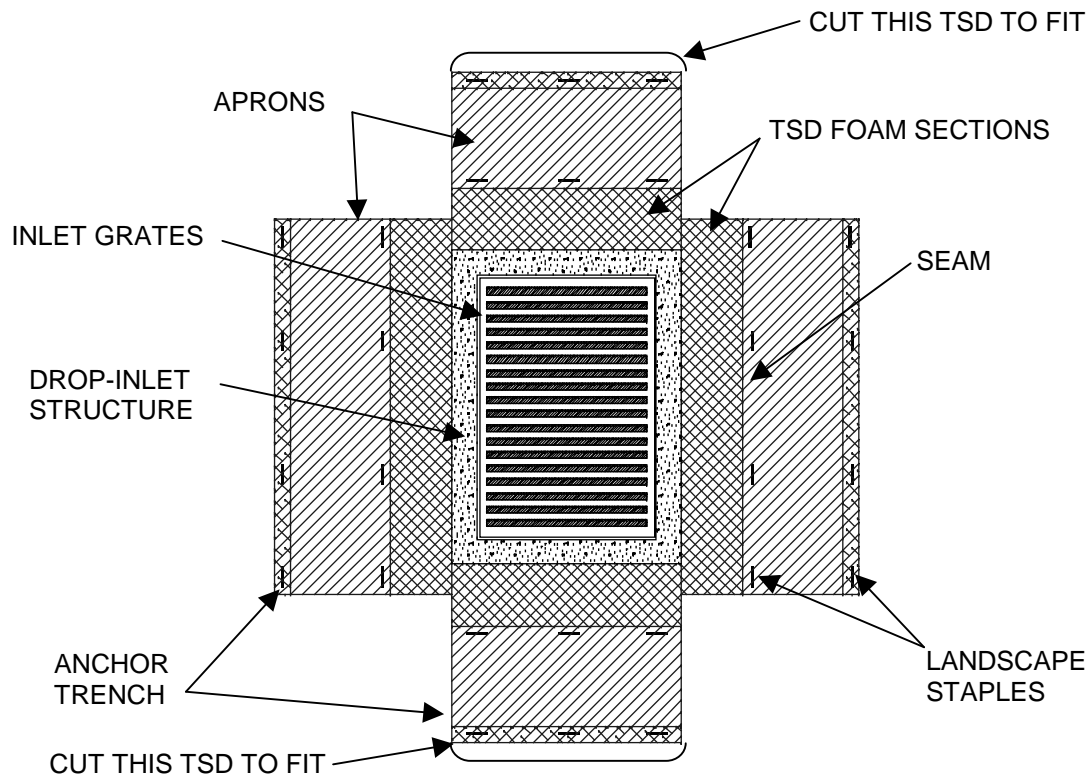
INSTALLATION

Note: The orientation of the TSD when installed as a drop-inlet barrier is different than when installed as a ditch check.

Proper Installation Method

- For a drop-inlet barrier installation, orient the TSD so that the side bordering the drop-inlet is vertical. Position the TSD aprons so that the shorter of the two aprons lies beneath the longer one. Neither apron should be under the foam portion of the TSD.
- Place two full sections (approximately 2.1 meters [7 feet] long each) of TSD against opposite sides of the drop inlet. These sections should extend beyond the edges of the drop inlet, do not cut these to fit. Excavate trenches that are at least 100 millimeters (4 inches) deep by 100 millimeters (4 inches) wide near the ends of the TSD apron so that the outer 200 millimeters to 260 millimeters (8 inches to 10 inches) of the apron can be buried. Lay the outer 200 millimeters to 260 millimeters (8 inches to 10 inches) of apron into the trench and anchor it with 150-millimeter to 200-millimeter (6-inch to 8-inch) landscape staples on 460-millimeter (18-inch) centers. Backfill the trench with the excavated soil and compact. Anchor the remainder of the apron with a row of 150-millimeter to 200-millimeter (6-inch to 8-inch) landscape staples on 460-millimeter (18-inch) centers along the seam of the TSD.
- In the spaces where the TSDs extend beyond the edges of the drop-inlet, cut new TSDs to fit. Make sure that a tight fit is achieved between the cut TSDs and the existing TSDs. These cut sections should be oriented and anchored in the same manner as the initial sections.
- **Note:** When a TSD drop-inlet barrier is placed in a shallow median ditch, make sure that the top of the barrier is not higher than the paved road. In this configuration, water may spread onto the roadway, causing a hazardous condition.

Figure 9-2 - Plan View - TSD™ Drop-Inlet Barriers



List of Common Placement/Installation Mistakes to Avoid

- TSDs should be placed directly against the perimeter of the drop inlet. This allows overtopping water to flow directly into the inlet instead of onto nearby soil, causing a scour hole.
- Make sure to orient the TSD properly. The side in contact with the drop inlet should be vertical, and the shorter apron should lie beneath the longer one.
- If the receiving apron of a TSD is not dug into the ground, water will flow underneath.

INSPECTION AND MAINTENANCE

TSD drop-inlet barriers should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Does water flow under the TSDs?**
Water flowing under the TSD usually is caused by not properly anchoring the TSD. Make sure that the receiving apron is trenched in and that an adequate number of staples have been used.
- **Does water flow through spaces between abutting TSDs?**
Water flowing through the spaces usually is caused by incorrect sizing of the cut sections. If the cut sections are too small, re-cut new sections so that they fit properly.
- **Does sediment need to be removed from behind the TSDs?**
Sediment accumulated behind the TSDs should be removed when it reaches one-half of the dike height. Allowing too much sediment to accumulate behind a TSD barrier drastically reduces its effectiveness. Because one high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the drop-inlet barrier, it is extremely important to inspect drop-inlet barriers within 24 hours of a heavy rainfall.

Helpful Hint – When removing sediment from behind a TSD with a bulldozer or backhoe, make sure not to hook the receiving apron with the blade. This will damage the barrier and it will have to be replaced.

Section 10 – Block and Gravel Inlet Barrier

PURPOSE AND OPERATION

Block and Gravel inlet barriers operate by intercepting, ponding and filtering the sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle. As the ponded water percolates through the Block and Gravel inlet barrier, much of the remaining suspended sediment is filtered out. Block and Gravel inlet barriers work well in areas of moderate flow and moderate slopes.

DESIGN

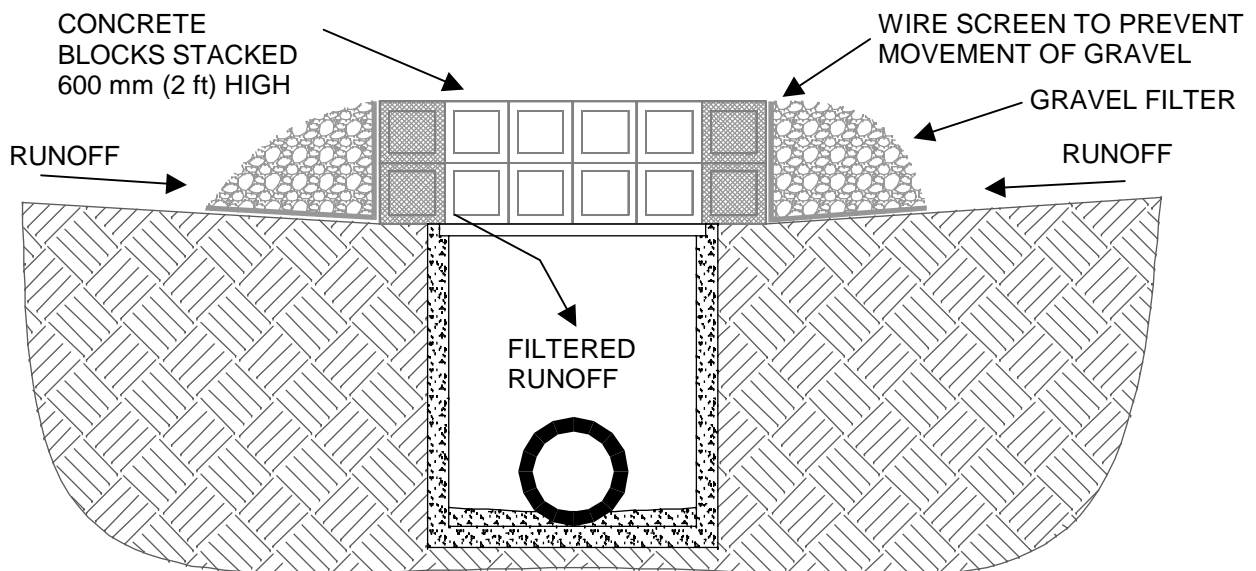
Material Specifications

- Concrete masonry blocks - 200 millimeters by 200 millimeters by 400 millimeters (8 inches x 8 inches x 16 inches)
- 10 millimeter (0.5 inches) wire screen
- 38 millimeter (1.5 inches) maximum size gravel

Placement

- Place Block and Gravel inlet barrier in a location where it is unlikely to be overtopped. Water should flow through the gravel, **not over it**.
- When a Block and Gravel inlet barrier is located near an inlet that has steep approach slopes, the storage capacity behind the barrier is drastically reduced. Timely removal of sediment must occur for a barrier to operate properly.

Figure 10-1 - Side View-Block and Gravel Inlet Barrier

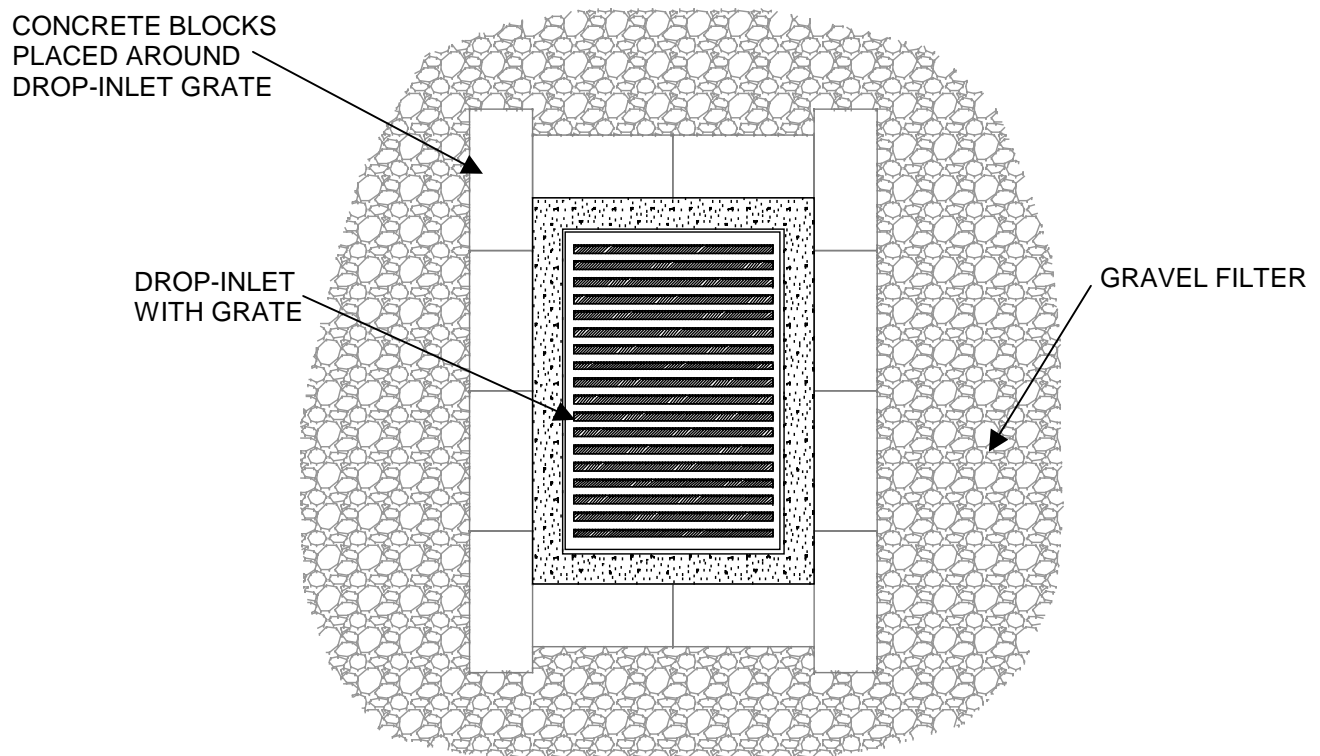


INSTALLATION

Proper Installation Method

- Place concrete blocks around the inlet structure to a height of 600 millimeters (2 feet).
- Place the wire screen against the blocks. The wire screen may have to be secured to the blocks to allow placement of the gravel.
- **NOTE:** When the Block and Gravel inlet barrier is placed in a shallow median ditch, make sure the top of the barrier is not higher than the road. Otherwise, water may spread onto the roadway causing a hazardous condition.

Figure 10-2 - Plan View-Block and Gravel Inlet Barrier



List of Common Placement/Installation Mistakes to Avoid

- Water should flow through a block and gravel inlet barrier, not over it. Place a block and gravel inlet barrier where it is unlikely to be overtopped.
- Ensure that the gravel has relatively few fine particles with the majority of the aggregate between the sizes of 10 millimeters (0.5 inches) to 35 millimeters (1.5 inches). This will ensure adequate flow capacity while allowing filtration to take place; in addition the gravel will be unable to pass through the wire screen.

INSPECTION AND MAINTENANCE

Block and Gravel inlet barriers should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Does water flow over the Block and Gravel inlet barrier?**
Although water flowing over the barrier can be caused by heavier flows, it is usually the result of sediment buildup. Clean out the sediment behind the gravel; and in certain cases, some of the gravel may have to be replaced if it is plugged with sediment. Sediment should be removed when one-half the depth of the barrier is achieved.
- **Is there gravel in the inlet?**
Gravel in the inlet usually is caused by gravel with a smaller diameter than the wire screen. Increase the diameter of the gravel or decrease screen size.
- **Is there sediment in the inlet?**
Sediment in the inlet usually is caused by gravel too large in diameter or by an insufficient amount of gravel to filter out sediment. Reduce gravel diameter, or increase the amount of gravel around the inlet.

Helpful Hint – If possible, leave the gravel around the inlet to dissipate energy from the water. This allows the sediment to settle prior to the water entering the inlet. The gravel should be leveled out, so that the water doesn't pond once the site is stabilized.



Section 11 – Drop-Inlet Gravel and Wire-Mesh Filter

PURPOSE AND OPERATION

A drop-inlet gravel and wire-mesh filter operates by intercepting, ponding and filtering the sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle. As the ponded water percolates through the gravel, much of the remaining suspended sediment is filtered out. Drop-inlet gravel and wire-mesh filters work well in areas of moderate flow and relatively flat slopes.

DESIGN

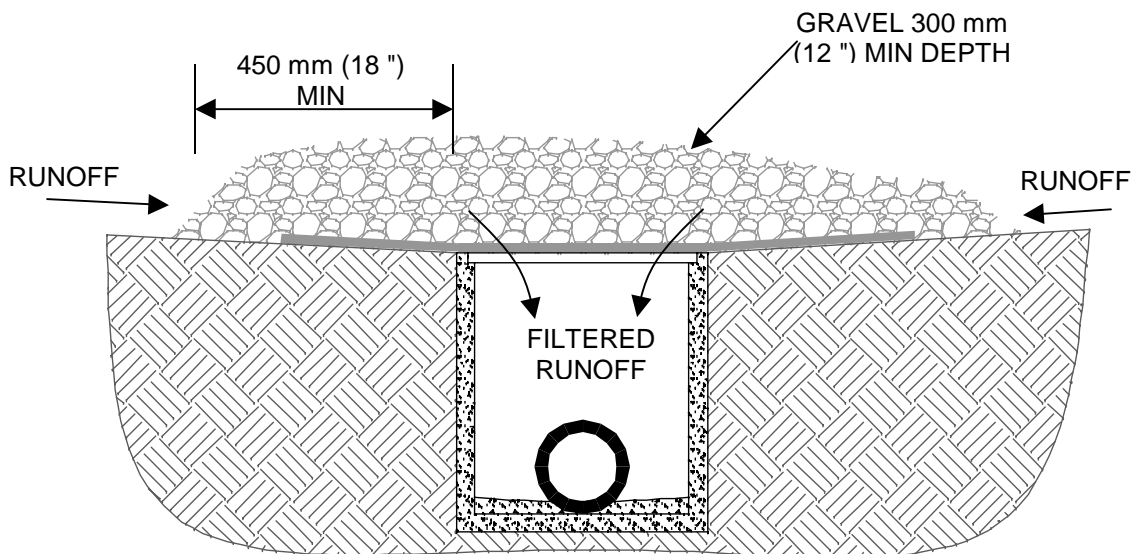
Material Specifications

- 10 millimeter (0.5 inches) wire screen
- 38 millimeter (1.5 inches) maximum size gravel

Placement

- Place a drop-inlet gravel and wire-mesh filter in areas of shallow ditches and relatively flat slopes. Ensure that if water is ponding, it will not overtop the roadway and create a hazardous condition.

Figure 11-1 - Side View - Drop-Inlet Gravel and Wire-Mesh Filter



INSTALLATION

Proper Installation Method

- Place the wire screen over the inlet grate. The wire screen may have to be secured to the grate to allow placement of the gravel.
- **Note:** When the drop-inlet gravel and wire-mesh filter is placed in a shallow median ditch, make sure the top of the gravel is not higher than the road. Otherwise, water may spread onto the roadway causing a hazardous condition.

List of Common Placement/Installation Mistakes to Avoid

- Water should flow through the gravel.
- Ensure that the gravel has relatively few fine particles with the majority of the aggregate between the sizes of 10 millimeters (0.5 inches) to 35 millimeters (1.5 inches). This will ensure adequate flow capacity while allowing filtration to take place; in addition the gravel will be unable to pass through the wire screen.

INSPECTION AND MAINTENANCE

Drop-inlet gravel and wire-mesh filters should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Is there gravel in the inlet?**
Gravel in the inlet usually is caused by using gravel with a smaller diameter than the wire screen. Increase the diameter of the gravel or decrease screen size.
- **Is there sediment in the inlet?**
Sediment in the inlet usually is caused by gravel too large in diameter or by an insufficient amount of gravel to filter out the sediment. Reduce gravel diameter, or increase the amount of gravel around the inlet.

Helpful Hint – If possible, leave the gravel around the inlet to dissipate the energy from the water. This allows the sediment to settle prior to the water entering the inlet. The gravel should be leveled out so that the water doesn't once the site is stabilized.

Section 12 – Drop-Inlet Sediment Trap

PURPOSE AND OPERATION

Drop-inlet sediment traps operate by intercepting and ponding the sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle. Drop-inlet sediment traps work well in areas of moderate flow and flat terrain.

DESIGN

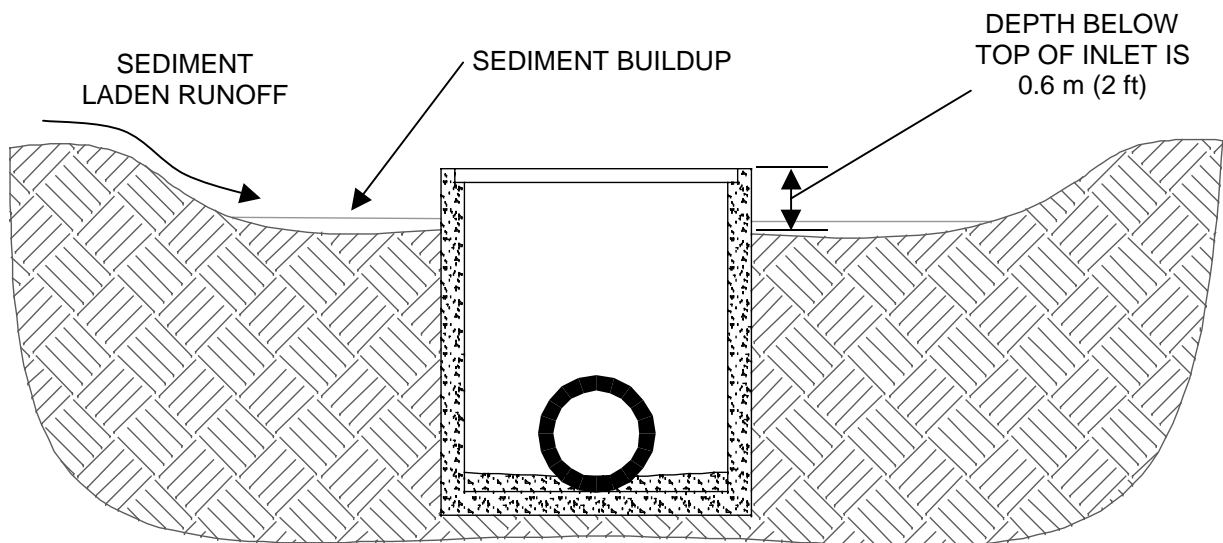
Material Specifications

- No materials required.

Placement

- Place a drop-inlet sediment trap in a location where it is unlikely to be inundated with drainage from the entire site, unless this area is relatively small.
- When a drop-inlet sediment trap is located near an inlet that has moderate slopes, the storage capacity behind the sediment trap is drastically reduced. Timely removal of sediment must occur for a sediment trap to operate properly.

Figure 10-1 - Side View - Drop-Inlet Sediment Trap



INSTALLATION

Proper Installation Method

- Around the inlet, excavate an area 3 meters (10 feet) by 0.6 meters (2 feet).
- **Note:** When the drop-inlet sediment trap is placed in a flat terrain, make sure the excavated area is large enough for the sediment to settle before the water enters the inlet. The excavated area should be at least the dimensions above, however site conditions may dictate a larger area.

List of Common Placement/Installation Mistakes to Avoid

- Water should pond to allow settling of the sediment. Ensure the excavated area is large enough to reduce velocity of the water entering the inlet so that the sediment can settle.
- Ensure the excavated area is deep enough for sediment collection.

INSPECTION AND MAINTENANCE

Drop-inlet sediment traps should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following question should be addressed during each inspection:

- **Is there sediment in the inlet?**
Sediment in the inlet usually is caused by an insufficient excavated area or sediment buildup. Clean out the sediment, or excavate a larger area.

Helpful Hint – If the area cannot be excavated to a size large enough to allow settling of the sediment, place a piece of filter fabric over the inlet to filter the incoming water. Although this procedure will require frequent fabric replacement, it will reduce the size of the excavated area. This procedure should not be used in areas where flooding may cause damage, as the fabric will become clogged very quickly if the water contains a lot of suspended sediment.



Section 13 – Temporary Erosion-Control Blankets

PURPOSE AND OPERATION

Erosion-control blankets are used to help limit erosion and establish vegetation on slopes and in ditches where conventional seeding and/or structural methods would be inadequate. By reducing the negative effects of rainfall impact and runoff, erosion-control blankets provide slopes and ditches with a temporary, stable environment for seed to germinate.

Temporary erosion-control blankets are constructed of a variety of materials, including straw, wood excelsior, coconut or some combination thereof. These materials usually are stitched or glued to some type of synthetic or natural fiber netting, that is either biodegradable or photodegradable (broken down by light).

DESIGN

Material Specifications

- All material used shall conform to sections 708.03, 856.01 and 856.02 of *the NDDOT Standard Specifications for Road and Bridge Construction, 1997 Edition*.

Placement

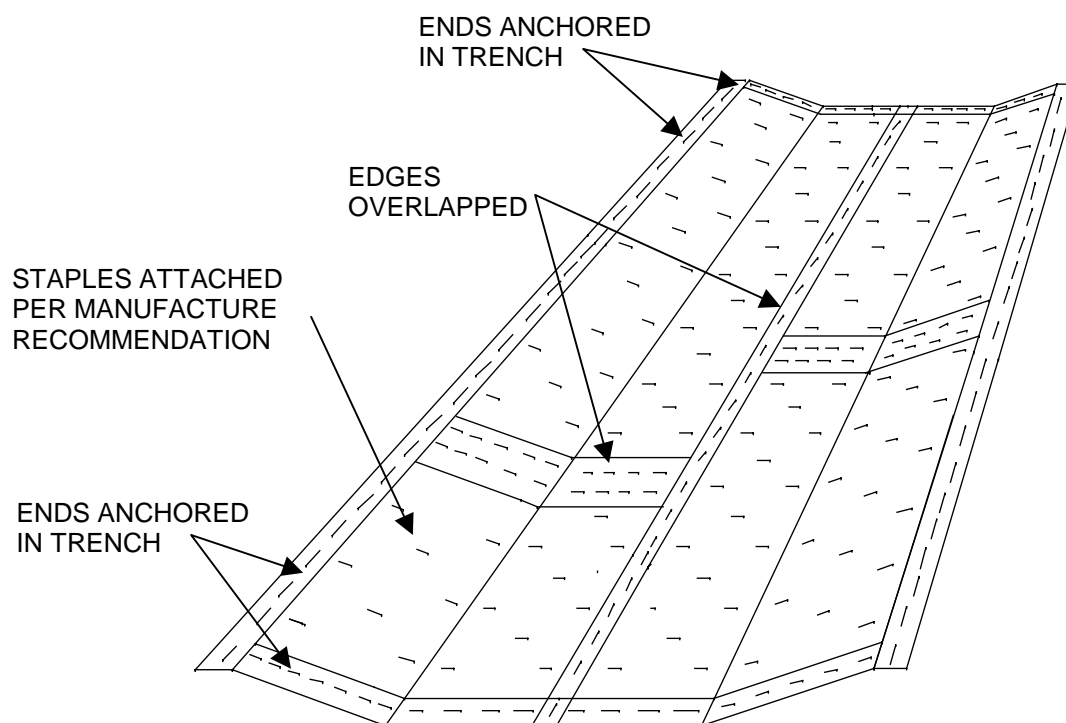
- The erosion-control blankets should be used in areas of high flow and/or steep slopes where erosion will occur before grass growth.
- The blankets also should be placed in areas of poor soil quality hinders for normal grass growth.

INSTALLATION

Proper Installation

- Prepare the soil and apply the seed before installing blankets.
- Anchor the blankets into a 150 millimeter by 150 millimeter (6 inches x 6 inches) trench. Backfill and compact the trench after stapling the blanket in accordance with the manufactures recommendations.
- Roll out the blanket in the direction of flow.
- Overlap the ends of the blanket if additional rolls are needed. Place the upstream blanket on top of the new roll and staple. Use a double row of staples staggered 100 millimeters (4 inches) apart. A minimum overlap of 300 millimeters (1foot) is required.
- Continue to place blankets in the above fashion, remembering to overlap all edges.
- The terminal end of the blankets must be anchored as stated above.
- Refer to the manufacture's recommendations for the number of staples to be placed per square yard based on slope and flow characteristics.

Figure 13-1 - Plan View - Temporary Erosion-Control Blanket



List of Common Placement/Installation Mistakes to Avoid

- Ensure the ends are properly secured.
- Install a sufficient number of staples to hold the blanket in place.
- Overlap the blanket to ensure water that flows on top of the blanket and is unable to flow under the blanket.

INSPECTION AND MAINTENANCE

Temporary erosion control blankets should be inspected every seven days and within 24 hours of a rainfall of 10 millimeters (0.5 inches) or more. The following questions should be addressed during each inspection:

- **Are the ends pulled out?**
Pulled out ends are usually caused by not properly installing them. Repeat the anchoring procedures for the ends, installing additional staples or increasing the trench size as necessary to ensure that the installation is secure.
- **Are the seams together?**
If the seams are pulled apart, the blanket was not properly installed. Reinstall at the seams, adding more staples if necessary to hold the material in place.

- **Is the blanket sagging or misplaced?**

A sagging or misplaced blanket usually is caused by lack of staples. Reinstall the blanket, using the correct number of staples.

Helpful Hint – If at all possible, use a biodegradable or photodegradable erosion-control blanket. Using this type of product, will save money because the blanket can be left it in place. No additional time or resources will have to be exhausted to remove the material.

Section 14 – Seeding

PURPOSE AND OPERATION

Seeding is by far the most efficient and cost-effective method for controlling on-site erosion. The key to controlling erosion with seeding is the timeliness of the application. Seeding should be initiated within seven days after grading activities have temporarily or permanently ceased on a portion of the project site. On-site erosion and off-site sedimentation will continue to occur as long as a section of exposed earth remains.

PLACEMENT AND INSTALLATION

Specific project plans outline the amount and type of seed to be used. Consult the NDDOT Standard Specifications, Section 708, Erosion Control, for soil preparation, seed and mulching requirements.



ADDITIONAL RESOURCES

If you wish to learn more about temporary erosion control and the NDPDES permitting process, the following resources may be helpful:

TEMPORARY EROSION CONTROL

- *Best Management Practices for Erosion and Sediment Control*. Report No. FHWA-FLP-94-005. A copy of this publication can be obtained from Federal Highway Administration at:

U.S. Department of Transportation
Federal Highway Administration
Federal Lands Highway Program
Washington, D.C. 20590

NDPDES PERMITS

- North Dakota Pollutant Discharge Elimination System Stormwater Discharge Permit Application Packet. A copy of this packet can be obtained from NDDoH at:

North Dakota Department of Health
Division of Water Quality
PO Box 5520
Bismarck, ND 58506-5520
701.328.5242

 **NOTES**
