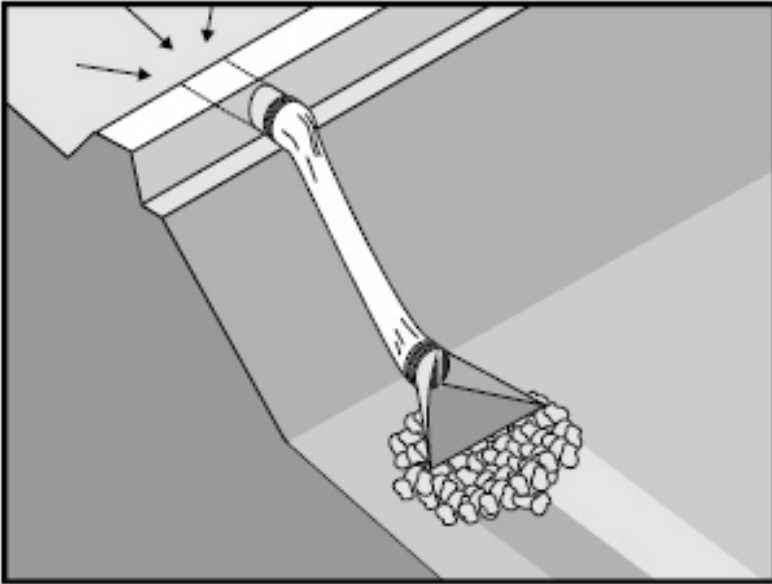


# Slope Drain



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A slope drain is a pipe or other form of conduit used to reduce the risk of erosion on unstabilized slopes. Slope drains intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Consisting of a metal or plastic flexible pipe if temporary, or pipes or paved chutes if permanent, these drains carry surface runoff from the top to the bottom of a slope that has already been damaged by erosion or is at high risk for erosion. Slope drains are used in conjunction with other BMPs like earth dikes and drainage ditches.

## Usage

- provide effective erosion control before a slope can be stabilized, or before permanent drainage structures are ready to use
- used to drain saturated slopes that have the potential for soil slides
- as an emergency spillway for sediment basins

## Benefits

- reduces or eliminates erosion by transporting runoff down steep slopes or by draining saturated soils in a controlled manner
- highly effective for transporting runoff down a disturbed slope with minimal erosion

## Limitations

- area drained by this mitigation measure should not exceed five acres
- a common slope drain problem is overtopping of the inlet due to an undersized or blocked pipe, or erosion at the outlet point due to insufficient protection
- may clog during a large storm
- construct the area around the inlet carefully to prevent water from flowing around the inlet and breaching the diversion
- severe erosion is typical if the slope drain fails
- requires proper installation and strict maintenance to prevent failure

## Estimated Cost

Varies; based on pipe selection and selected outlet protection. Site-specific cost estimates can be produced using unit cost values with site-specific quantity estimates. A range of pipe costs for surface placement between \$5.00 per linear foot for 4-inch diameter and \$9.20 per linear foot for 10-inch diameter PVC piping. Temporary inlets and outlets are usually formed by small rock-lined depressions. Assuming 4 cubic yards of crushed rock per opening, an inlet and outlet together add approximately \$200 per pipe installation, based on \$25 per cubic yard of stone (R. S. Means, 2000).

## Alternatives

- Earth Dike & Drainage Swale (p. 2-4)

## Notes:

Maximum Drainage Area (acres)	Pipe/Tubing Diameter <sup>a</sup> (inches)	Pipe/Tubing Diameter <sup>b</sup> (inches)	Pipe/Tubing Diameter <sup>c</sup> (inches)
0 - 0.5			
0.5	12	12	8
0.75			10
1.0			12
1.5	18	18	Individually designed
2.5	21		
3.5	24	24	
5.0	30		

Summary of recommended slope drain dimensions from three sources (a, b, and c), courtesy of: USEPA, 2004.

## Installation Tips

Inlet structures must be securely entrenched and compacted to avoid severe gully erosion. Slope drains must be securely anchored to the slope and adequately sized to carry anticipated runoff volumes.

When installing slope drains:

- stabilize the area disturbed by the installation of the drain or it will be subject to erosion
- install slope drains perpendicular to slope contours
- compact the soil around/under inlet, outlet, and along pipe length
- anchor and stabilize pipe securely into soil
- check to ensure that pipe connections are watertight
- protect area around inlet with filter cloth and protect outlet with riprap or other energy dissipation device; high energy discharges require reinforcement riprap with concrete or reinforced concrete device
- improve the flow into the slope drain and prevent erosion at the pipe entrance by installing a flared end section (minimum 6 in toe plate) at the inlet; the flared section should slope toward the pipe inlet
- The entrance to the pipe should consist of a standard flare end section of corrugated metal. The corrugated metal pipe should have watertight joints at the ends. The rest of the pipe is typically corrugated plastic or flexible tubing, although for flatter, shorter slopes, a polyethylene-lined channel is sometimes used.
- detailed installation tips can be found in the ODNR Rainwater and Land Development manual

## Maintenance

- inspect daily during extended rain events
- inspect weekly for erosion and downstream scour; if eroded, repair damage and install additional energy dissipation measures
- check for holes within the pipe and repair immediately when needed
- repair undercutting at inlet; if needed, install flared section or riprap around the inlet to prevent further undercutting
- remove built-up sediment from entrances and outlets as required
- flush drains if necessary; capture and settle out sediment from discharge
- inspect for inlet blockage

## Vendors

See Appendix page F17

## References

California Stormwater Quality Association (CASQA). 2003. California stormwater best management practices handbook for construction.

R.S. Means. 2000. Building Construction Cost Data 58th Annual Edition. R.S. Means Co., Kingston Massachusetts.

UNEP (United Nations Environment Program). 1994. Guidelines for sediment control practices in the insular Caribbean. CEP Technical Report No. 32 UNEP Caribbean Environment Programme, Kingston, Jamaica.

USEPA (United States Environmental Protection Agency). 2004. Development Document for Final Action for Effluent Guidelines and Standards for the Construction and Development Category. USEPA, Washington, D.C.