Permanent Slope Diversions

Description

Permanent slope diversions are designed to transport runoff down a slope in a manner that minimizes the potential for erosion. Diversions can be constructed by creating channels laterally across slopes to intercept the down-slope flow of runoff. The channels have a supporting earthen ridge on the bottom sides to reduce slope length, collect stormwater runoff, and deflect the runoff to outlets that convey it without causing erosion.

Applicability

Diversions should be considered for use on slopes where uncontrolled runoff might cause property damage due to erosion or resulting sedimentation. They can also be used to promote the growth of vegetation by redirecting flows while the vegetation is becoming established.

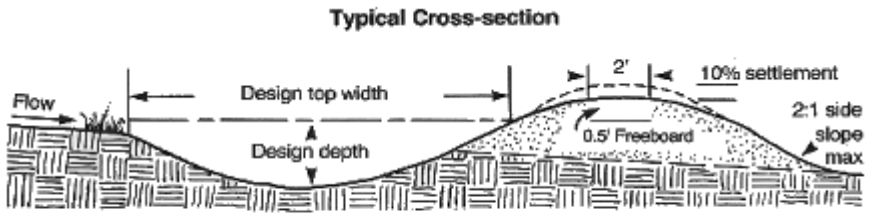
Siting and Design Considerations

A properly designed earthen ridge typically has side slopes no steeper than 2:1, a width at the design water elevation of at least 4 feet, a minimum freeboard of 0.3 foot, and a 10 percent settlement factor included in the design (reference?).

A stormwater conveyance channel can be vegetated or hardened (e.g., with rock or concrete). Both types should be sufficient in shape and size to carry stormwater runoff away from developing areas without any erosion damage. Paved flumes are not recommended unless very high flows with excessive erosive power are expected because faster runoff might exacerbate erosion at the flume's outfall. Paved flumes also prevent surface runoff from infiltrating, which can cause increased volumes and erosive forces of the runoff that leaves the site. Adequate outfall protection should be provided to prevent damage from the discharge of high-velocity flows. Where possible, vegetated channels should be used to minimize flow velocity and to enhance pollutant removal. Riprap, gabions, or turf reinforcement mats can provide additional channel stabilization.

The following are general specifications required for channel construction:

- Remove all obstructions and unsuitable material, such as trees, roots, brush, and stumps, and any excess soil from the channel area and dispose of them properly.
- Make sure the channel meets grade and cross section specifications, and compact any fill used to ensure equal settlement.
- Parabolic and triangular, grass-lined channels should not have a top width of more than 30 feet.
- Trapezoidal, grass-lined channels may not have a bottom width of more than 15 feet unless there are multiple or divided waterways, they have a riprap center, or other methods of controlling the meandering of low flows are provided.
- If grass-lined channels have a base flow, provide a stone center or subsurface drain or another method for managing the base flow.



Site planners incorporate diversions into the overall grading plan to direct clean runoff away from exposed areas

All channels must have outlets that are protected from erosion. Locate structurally lined aprons or other appropriate energy-dissipating devices at channel outlets to slow stormwater flows and prevent scouring at stormwater outlets, protect the outlet structure, and minimize the erosion potential downstream. Construction specifications for outlet protection practices require the following:

- No bends occur in the horizontal alignment.
- There is no slope along the length of the apron, and the invert elevations are equal at the receiving channel and the apron's downstream end.
- No overfall at the end of the apron is allowed.
- If a pipe discharges into a well-defined channel, the channel's side slopes may not be steeper than 2:1.
- The apron is lined with riprap, grouted riprap, concrete, or gabion baskets; all riprap conforms to standards and specifications; and the median-sized stone for riprap is specified in the plan.
- Filter cloth, conforming to standards and specifications, must be placed between riprap and the underlying soil to prevent any soil movement through the riprap.
- All grout for grouted riprap must be one part Portland cement for every three parts sand, mixed thoroughly with water. Once stones are in place, the spaces between them are to be filled with grout to a minimum depth of 6 inches, with the deeper portions choked with fine material.
- All concrete aprons must be installed as specified in the plan.
- The end of the paved channel in a paved channel outlet must be smoothly joined with the receiving channel section, with no overfall at the end of the paved section.

Limitations
Immediately after constructing a vegetated ridge and channel, seed and mulch them along with any disturbed areas that drain into the diversion. To prevent soil from moving into the diversion, sediment-trapping measures must remain in place in case the upslope area is not stabilized. Remove all obstructions and unsuitable material, such as trees, brush, and stumps, from the channel area and dispose of them so the diversion can function properly. The channel must meet grade and cross section specifications. Make sure any fill used is free from excessive organic debris, rocks, or other unsuitable material. Compact the fill to ensure equal settlement. Permanently stabilize disturbed areas according to applicable local standards and specifications. Stabilize the area around the channel that is disturbed by channel construction so that it is not subject to erosion similar to that of the slope the channel is built to protect.

Maintenance Considerations
Inspect diversions after every rainfall and at least once every 2 weeks before final stabilization. Clear channels of sediment, make repairs when necessary, and reseed seeded areas if a vegetative cover is not established.

Costs
Costs of slope drains vary based on pipe (material) selection, length, and the outlet protection that is used. Supplied and installed costs (not inlcuding trenching) for corregated steel pipe ranges from less than $20 per linear foot for 12" pipe to more than $50 per linaer foot for 3o" pipe and from less than $25 per linear foot to $130 per linear foot (also supplied and installed, exclusing trenching) for PVC pipe (CASQA Handbook)

References

CASQA, 2003.*California Constrcution BMP Handbook*Section 3; EC-11-Slope Drain Fact Sheet. http://www.cabmphandbooks.org/Construction.asp

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