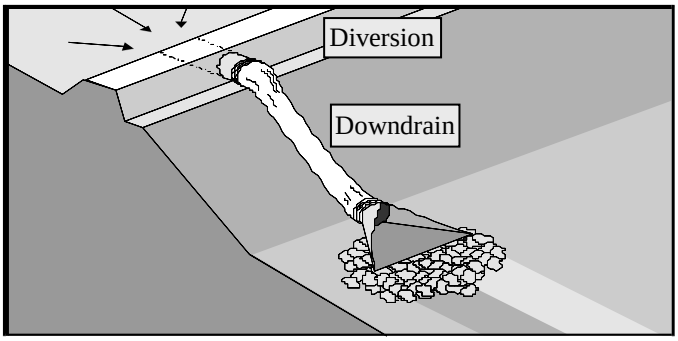
ACTIVITY: Diversions and Downdrains | ES – 21



CITY OF KNOXVILLE

Targeted Constituents				
● Significant Benefit	◗ Partial Benefit	○ Low or Unknown Benefit		
● Sediment	○ Heavy Metals	○ Floatable Materials	○ Oxygen Demanding Substances	
○ Nutrients	○ Toxic Materials	○ Oil & Grease	○ Bacteria & Viruses	○ Construction Wastes

Description

Temporary diversions and downdrains divert stormwater runoff from upstream stabilized areas around the construction site and other disturbed areas, preventing offsite stormwater from causing erosion on slopes. Diversions also may be used to collect stormwater from disturbed areas and direct runoff into sediment basins or traps. The primary function of diversion channels and downdrains is to minimize sheet flow over slope surfaces and convey collected runoff to a sediment-removing structure or a protected drainage system, as appropriate. This practice will significantly reduce sediment.

Suitable Applications

- Diversions are appropriate upslope from a disturbed area, to prevent offsite stormwater runoff from eroding the disturbed area.
- Diversions are appropriate downslope from a disturbed area, to convey stormwater runoff to a sediment trap, sediment basin, or other sediment-capturing device.
- Diversions may also be used at material storage areas, equipment maintenance and fueling areas, or other areas where runoff may have contaminants or pollutants.
- Diversions can be placed in the middle of a long slope or at other areas within the project site, to reduce slope lengths and the potential quantity of soil erosion.
- Diversions can be located to protect adjacent property and buildings from potential damage from stormwater runoff.
- Downdrains are used to convey stormwater runoff from the top of a slope to the bottom of a slope in a safe manner, so that slope erosion does not occur.

Approach

Diversions and downdrains are essential in keeping erosion and sediment confined to the disturbed portions of a construction site. It is beneficial to stabilize disturbed areas as soon as possible, and to prevent stormwater from traversing disturbed slopes. Diversions and downdrains do not remove sediment from runoff, but they are needed to control stormwater during construction and, if properly designed by a professional engineer, as part of the permanent drainage system.

Temporary diversion channels need to be sized adequately (typically 5-year or 10-year design storm) with a channel lining that will resist the design flows and velocities. Temporary downdrains should be designed to handle diverted flows without excessive ponding at the entrance and without excessive exit velocities. The downdrain outlet will typically require large sizes of riprap, splash blocks, energy dissipators or other types of

structures (see ES-24, Outlet Protection).

Slopes that are formed during cut and fill operations should be protected from erosion. Diversions and swales at the top of slope divert runoff to a location where it is safely conveyed to the bottom of slope. Install diversion and downdrain structures when the site is initially graded; remove them after disturbed areas are permanently stabilized.

Other BMPs which also protect slopes from erosion and stormwater runoff include:

ES-14	Silt Fence	ES-16	Sandbag Barrier
ES-15	Straw Bale Barrier	ES-17	Brush or Rock Filter Berm

Temporary Diversions

Diversion channels must not adversely impact adjacent properties. Once stabilized with temporary vegetation or linings, diversions require relatively little maintenance. Diversions are relatively inexpensive to install since they are formed as part of the initial grading operations, while heavy equipment is still operating at the site. Earthen dikes and diversions can be easily constructed by one or two passes of a bulldozer or grader, and then compacted by a few passes of the same tracked or wheeled equipment. See Figure ES-21-1 for a typical grading detail.

Select design flows and safety factors based upon careful evaluation of risks from overtopping, backwater or ponding, washouts, scour or erosion. High flow velocities may require the use of a lined ditch or other means of control. Generally, diversion channels and swales should not radically alter predevelopment flow patterns. A typical grass diversion swale is placed with 1 percent slope and maximum slope of 3 percent.

Remove all trees, stumps, obstructions or other objectionable material from the path of the diversion channel or swale. Grade the disturbed areas and compact fill material as necessary. Stabilize all diversions and swales immediately using erosion control matting, mulch, geotextiles, etc. Construction equipment may cross a diversion or swale at designed locations which have reinforced materials or a culvert.

Temporary Downdrains

Downdrains can be placed either on top of a slope or buried underneath the slope surface. Downdrains placed on top of a slope will need to be anchored more securely than buried downdrains. Use anchors to hold pipes together, in addition to the normal pipe connections used for particular pipe materials (coupling bands, slip-on connections, bolts or screws). See Figure ES-21-2 for typical downdrain details.

When using temporary downdrains without formal drainage computations, limit the tributary area to 2 acres per pipe. For larger areas, use a rock-lined channel or a series of pipes. Maximum slope of a downdrain may not be more than 2:1 (H:V) and should preferably be as flat as possible, to reduce the need for energy dissipation measures.

Downdrains in critical areas should be substantially overdesigned and may also incorporate an emergency overflow section or bypass. If a downdrain conveys sediment-laden stormwater, then direct flows to a sediment trap or sediment basin.

Install downdrains perpendicular to slope contours, unless forces on a downdrain pipe are properly computed to resist movement. Compact soil at downdrain pipe inlet and outlet, and throughout the length of pipe. Securely anchor pipe and appurtenances into ground. Check to ensure that all pipe connections are watertight. Protect downdrain inlet and outlet by installing a flared-end section, riprap, concrete, geotextile filter fabric, or energy dissipating devices.

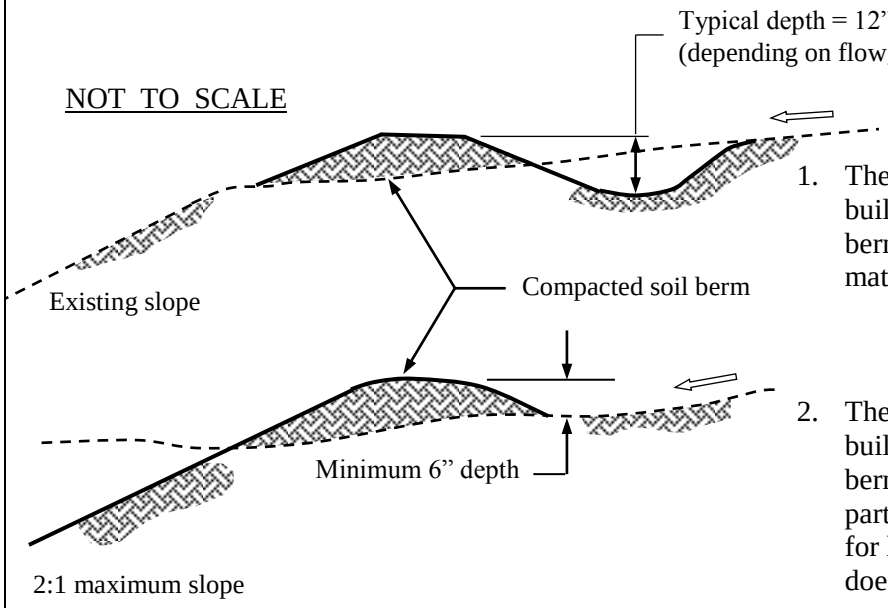
Maintenance

- Inspect diversions and downdrains after each rainfall, and weekly until the tributary drainage area has been stabilized. Remove built-up sediment and debris from entrances and outlets as required. Flush drains if necessary; capture and settle out sediment from discharge.
- Inspect outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventative measures are implemented.

Limitations

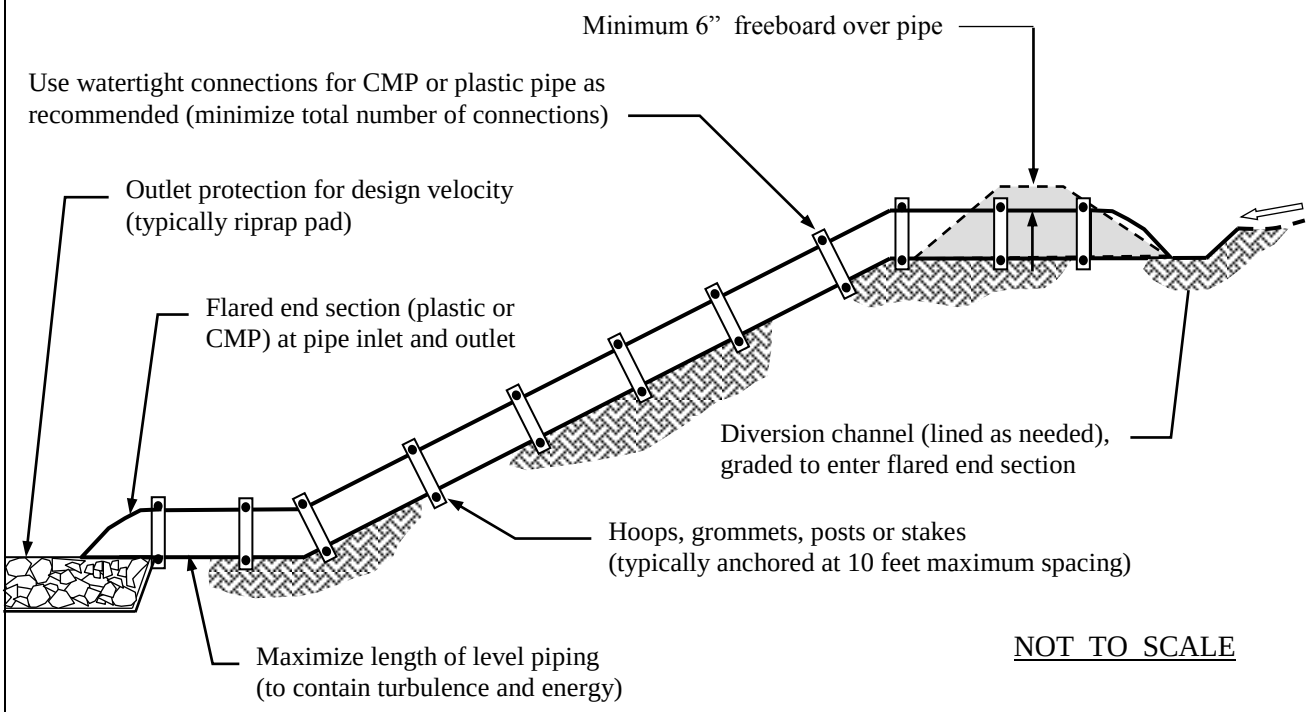
- Temporary diversions or berms should not be used for drainage areas greater than 2 or 3 acres, or along slopes greater than 10 percent. Earthen dikes and diversions must be stabilized immediately. Use materials and soils which are not subject to erosion. Earthen dikes and diversions may become barriers to construction equipment and materials being transported.
- Temporary diversions, downdrains, swales or any other runoff should not adversely impact upstream or downstream properties. Diverted stormwater may cause downstream flood damage if not properly controlled or evenly distributed.
- Severe erosion may result when downdrains fail by overtopping, pipe separation or collapse, piping within surrounding uncompacted soil, slippage or sliding, or other type of damage. Subsurface drains may remove fine soils which can result in collapse of the slope.

References **5, 8, 9, 30, 33, 34, 35, 43, 54, 114, 141, 144, 162, 167, 179**
(see BMP Manual Chapter 10 for list)



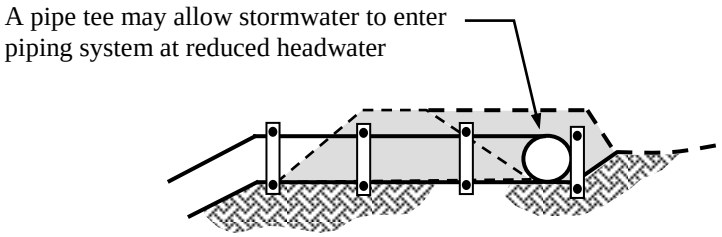
1. The top detail shows a diversion channel built at the top of an existing slope. A berm is constructed from excavated material for the diversion channel.
2. The bottom detail shows a diversion berm built at the top of a proposed slope. A berm is formed and smoothly graded as part of slope excavation and compaction, for locations where flow is minimal and does not warrant a channel.

Figure ES-21-1
Typical Diversions



NOT TO SCALE

Diameter of downdrain pipe	Maximum drainage area
10"	0.30 acres
12"	0.50 acres
15"	0.75 acres
18"	1.00 acres
21"	2.00 acres



ALTERNATE ENTRANCE

Notes:

1. Plastic corrugated pipe, or other types of flexible piping, is highly recommended for downdrains and will essentially eliminate connections.

2. Place sandbags or other heavy objects adjacent to downdrain to help prevent lateral movement.

3. Ensure that all connections are watertight, and that the diversion berm and channel are well-compacted at the top of slope. Mechanical compaction may be necessary to eliminate potential

Figure ES-21-2
Typical Downdrain Details