SLOPE DRAIN

Slope drains are heavy duty, often flexible, pipes that convey runoff from the top of a slope to the bottom of a slope. This runoff diversion practice is used to prevent concentrated runoff from flowing directly over the bare face of the slope thereby reducing erosion and, in some cases, slope failure.

Slope drains are installed with water containment or diversion structures, such as interceptor/diversion swales, berms, or barriers that help collect and convey upslope runoff towards the slope drain

On long slopes the installation of terraces across the slope face will also mitigate erosion from sheet flow over the bare soil of the slope. The terraces intercept runoff and direct them to the slope drain pipe, thereby preventing the formation of rills and gullies on the slope.

Prevent erosion on susceptible bare soil areas by ***diverting*** and ***intercepting*** runoff using practices like:

- Interceptor swales
- Berms
- Barriers
- Slope drains

Application

- Exposed slopes where runoff is being conveyed from top to bottom
- Where it is anticipated that concentrated flows will flow over the slope face
- Particularly important on long and/or steep slopes
- In conjunction with a multi-barrier approach that includes water detention and/or diversion measures.

Figure B1-3: Slope drain

Design and installation

- Calculate the pipe size based on maximum flows to be conveyed in the drain and provide on ESC plan drawings. The “Specified Flood Risk” calculation detailed in Appendix A may be applied for calculating return periods when sizing slope drains, particularly where the drain conveys water into or close to a natural feature. The calculation considers the acceptable level of risk (if the drain was to be overtopped) and the anticipated service life of the swale in determining the return period. This may be useful where there is a low tolerance of risk of failure and/or the slope drain will be in place for a long time.
- Once the return period is established, determine maximum flow volumes to be conveyed based on the size and runoff coefficient of the contributing drainage area.
- Ensure proper securement of the pipe ex. stakes, grommets, stones, etc. and securement spacing along the length of the slope drain.
- Ensure that pipe will extend beyond the toe of the slope to a flat area.
- Anticipate using more than one slope drain pending site drainage area and anticipated runoff flows.

- Inlet should include a berm and inlet protection. Install the slope drain and construct a compacted inlet berm (in 150 mm soil lifts) or barrier with a minimum of 0.45 m compacted soil cover above the top of the pipe to secure inlet.
- Direct the flows from the top of the slope to the proposed location of the slope drain.
- Place slope drain(s) on undisturbed soils or compacted fill per locations on construction drawings.
- Anchor pipes along the slope.
- Ensure erosion doesn't occur at the inlets and outlets by installing erosion mitigation pads at the inlet and energy dissipaters at the downstream end.
- Position outlet so that it does not discharge to unprotected soils a receiving waterbody without flowing into a multi-barrier sediment control measure.

Inspection tip

Always look out for seepage and scour to ensure your slope drain doesn't fail

Inspection and maintenance

- Inspect weekly, and before and after significant rainfall (see definition in Section 10.1.2) or snowmelt events, and keep a record of the inspection.
- Table B1-1 lists slope drain components to inspect and how common problems should be addressed.
- Inspect the length of the top of slope to ensure that runoff is being directed to the slope drain and is not flowing down slope face.
- Any repair or maintenance needs identified should be repaired within 48 hours or sooner if natural receptors are at imminent and foreseeable risk of adverse impact.

Decommissioning

- Ensure that areas receiving runoff are well-stabilized. If the final grading will result in runoff that was conveyed through the drain flowing over the slope, ensure that the slope is fully stabilized. If it has been seeded, vegetated, ensure that the seed/vegetation is fully established.
- Remove slope drains with as little disturbance of the slope as possible.
- Stabilize and restore all disturbed areas.

Prioritizing ***sustainability***

Reducing waste | Slope drain pipes can be reused elsewhere if not clogged with sediment and debris.

Preventing erosion | With runoff diverted, a dense vegetative cover can be more readily established on

Table B1-1: Recommended inspection and maintenance of slope drains

Items to inspect	Inspection findings	Maintenance/repairs needed
Inlet	Erosion and seepage around the inlet	- Consider re-grading to reduce the inflow angle. - Repair erosion, compact soil - Stabilize inlet area with flared end section, rolled erosion control or filter fabric and riprap. - Ensure pipe connections are watertight and that pipe is well secured.
	Sediment accumulation at the inlet	- Remove sediment when it begins to impede flow rates and compromise the ability of the pipe to convey all the water from the drainage area. - Sediment accumulation greater than one-third the height of the berm should be removed. - Consider stabilization of drainage area where possible.
Outlet	Erosion	- Repair erosion, compact soil. - Consider incorporating outlet flow dispersion (e.g. flared pipe end) and/or energy dissipaters. - Stabilize outlet (e.g. filter fabric and rip rap, rolled erosion control, vegetation)
	Sediment accumulation at the outlet	- Remove sediment when it begins to impede flow rates and compromise the ability of the pipe to convey all the water from the drainage area. - Consider stabilization of drainage area where possible.
Pipe	Detachment and/or seepage	- Ensure pipe is re-secured and well-anchored to the slope. - Consider improving anchoring methods to increase stability. - If pipe seepage is noted, inspect pipe connections and repair/replace sections that area leaking.
	Clogging	- When sediment accumulation in the pipe leads to clogging and impeded flow, the pipe should be flushed out. - If clogging is occurring too often, consider stabilization of drainage area and/or the installation of an inlet screen or grate to keep out larger debris.
	Overtopping	- Overtopping not caused by clogging indicates that the drainage area is too large of the flow velocity is too high for the pipe size used. - Address overtopping by reducing drainage area, increasing pipe size, or slowing flows. - Reducing drainage area requires re-grading and installing additional slope drains. - Where flow velocity is the issue, consider re-grading and installation of barriers (e.g. check dams) to slow down runoff conveyed to the drain.

Adapted from: “Pipe slope drains” in *Storm Water Management BMP Handbook* (South Carolina Dept. of Health and Environmental Control, 2005)