**Greenville County Technical Specification for:**

# WQ-23 MOUNTAINOUS AND STEEP SLOPE SITES

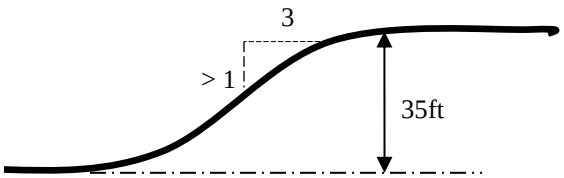
## 1.0 Mountainous and Steep Slope Sites

## 1.1 Description

The geographic locations of portions of Greenville County are unique with mountains, bluffs, hillsides, and ravines that can contain steep slopes. These slopes are highly susceptible to erosion caused by runoff of surface water. The removal of trees and other vegetation combined with new impervious surfaces accelerates the rate of erosion. This accelerated erosion and improper draining of surface water can leave slopes susceptible to significant erosion which can endanger persons and property. Since these areas are sensitive to development, ensure measures are taken to control stormwater runoff and erosion.

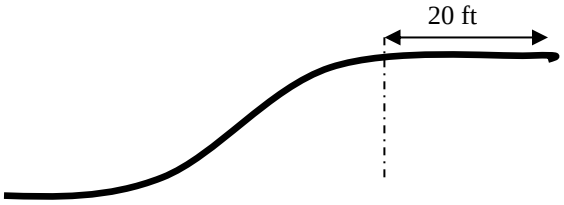
Steep slopes are designated as areas with slopes equal to or greater than a vertical rise of 1 foot for a horizontal run of 3 feet for a vertical height of 35 feet or more.

Steep Slope




Steep slope zones are areas between the bottom of a steep slope and 20 feet past the top of a steep slope.

Steep Slope Zone




## 1.2 Requirements

### 1.2.1 General Requirements

The following list includes general requirements for mountainous sites with steep slopes:

- Preserve 65 percent of the site in a forested or native condition for land development projects with steep slope zones. Ensure the effective impervious surface draining into the native vegetation is less than 10 percent of the entire site.

- Stormwater management emphasizes infiltration over conveyance and direct flows from impervious areas to infiltration BMPs.

- Maintain natural vegetation in a steep slope zone to maximum extent practicable with limited disturbance for building foundations, driveways, and other impervious surfaces. Minimize site grading to ensure predevelopment conditions are maintained. Preserve natural formations, existing trees and grades to the maximum extent practicable.

- Preserve natural channels and drainage waterways to the maximum extent practicable.

- Do not alter or obstruct the natural flow of surface or subsurface water by grade changes in any way that may adversely affect adjacent property by the pooling or collection of waters or by the concentration or intensification of surface water discharge.

- Perform and stabilize all land disturbance activities in steep slope zones in the shortest practical period of time. Remove all excess excavated materials from the steep slope zone. Temporary or permanent storage of material is not permitted within the steep slope zone.

- Restrictive covenants for the approval of subdivisions ensure long-term maintenance by the HOA/POA of permanent water quality and erosion control BMPs. The land being preserved in a forested or native condition is preserved in perpetuity through restrictive covenants as well.

- Grading, traffic, construction or storage of materials are not permitted beyond the limits of construction activity.

### 1.2.2 Grading Requirements

Design, landscape and stabilize all artificial slopes to create natural appearing slopes and hillsides to reduce the potential for erosion. Ensure artificial slopes do not exceed the steepness and height parameters listed in Table 1 except in circumstances where stable exposed rock is the intended end result of the artificial slope. The maximum height of a combined cut and fill slope may not exceed 60 feet.

**Table 1 – Artificial Slope Restrictions**

| ARTIFICAL SLOPES | | |
|---|---|---|
| **Slope Type** | **Maximum Slope** | **Maximum Height** |
| Cut Slope | 1.5 : 1 | 30 feet |
| | 2 : 1 | 40 feet |
| | < 2.5 : 1 | 30 feet |
| Fill Slope | 2 : 1 | 40 feet |
| | < 2.5 : 1 | 30 feet |

In addition to the artificial slope requirements, the following list includes grading requirements for Mountainous sites with steep slopes:

- In place of silt fence, use stabilized earthen berms reseeded on the downhill side or appropriately sized wattles/sediment tubes in steep slope zones.

- Establish interception ditches outside of a steep slope zone so soil is not saturated and the intercepted water is conveyed to the bottom of a slope to minimize erosion.

- Stabilize natural drainage ways by landscape integration, stone, rolled erosion control products (RECPs) or other means consistent with sound professional engineering practice. Ensure this stabilization continues below drainage and culvert discharge points to convey the discharge while minimizing channel erosion by using energy dissipation devices.

- Use retaining walls to preserve natural grade and site features and to prevent unnatural grading and to prevent erosion. The need for taller retaining wall heights may require the use of smaller stepped walls providing the necessary height while maintaining a natural scale and providing planting terraces. Retaining walls have a maximum height of 8 feet. Two or more terraced walls not exceeding 10 feet in height combined may also be used.

- Retaining walls erected for roads to access lots that are greater than 4 feet in height will be located 10 feet outside of the road right-of-way, and the retaining wall will be privately maintained.

### 1.2.3 Roadway Requirements

In mountainous developments, roads are the primary source of impervious area and concentrated runoff. Larger lot sizes often translate to longer mountain roads and driveways and more impervious area. Roadside ditches are also at risk of erosion and may contribute to downstream sediment impacts. Use the following requirements for Mountainous LID Sites.

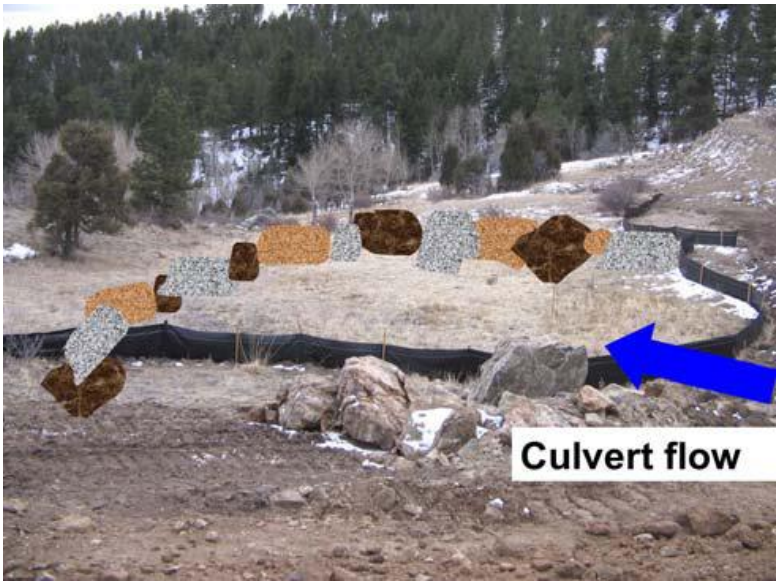
- Use stair stepped rock check dams or other erosion prevention BMPs consistent with sound professional engineering practice in roadside ditches in steep slope zones.

- When practical, use detention or infiltration structures designed within switchback curves used incrementally down steep slopes to reduce runoff volumes.

- When practical, convert temporary sediment traps or incorporate grassed stilling basins to provide detention and reduce runoff flow rates.

- Roadway culverts with diameters of 18 inches – 36 inches require a large rock ring (see Image 1 below) to establish a ponding area at the culvert outlet. The rock ring consists of 9-inch diameter $D_{50}$ or greater rip rap or large stones. The rock ring provides a detainment area of at least 500 square feet.

**Image 1 – Large Rock Ring**




From: PROMOTING STORMWATER INFILTRATION WITH MOUNTAIN CONSTRUCTION AND POST CONSTRUCTION BMPS

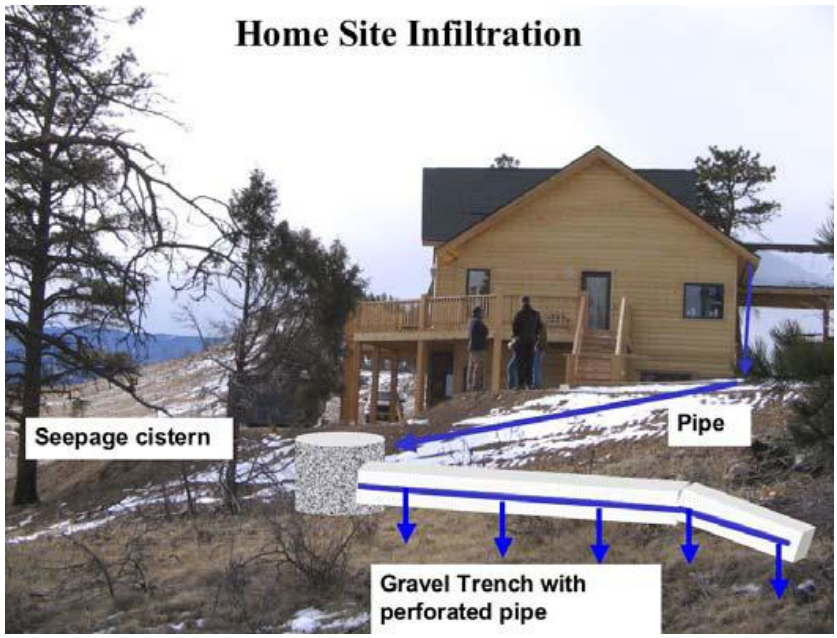
- Roadway culverts with diameters greater than 36 inches require discharge to a flow diffuser placed on the downhill side of the culvert. The flow diffuser discharges to a standard rip rap outlet protection.

### 1.2.4 Runoff Requirements

In mountainous developments, runoff from impervious structures and surfaces has an increased potential to concentrate runoff and cause soil erosion. When feasible, runoff from structures and impervious surfaces will drain to infiltration BMPs. It is recommended that a combination of infiltration BMPs be used to diffuse runoff flows. Alternate designs not listed below will require approval by Greenville County Land Development Division.

Seepage Cistern – See detail drawing WQ-23B and Image 2 below. The seepage cistern is designed to not overtop the gravel trench for the 10-yr 24-hr storm event. In large or intense storm events the trench and soil may become saturated. Select locations for gravel trench to follow natural contours to allow surfacing water to sheet flow through a natural landscape.

**Image 2 – Seepage Cistern**

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Dry Well – See Greenville Technical Specification WQ-18A Section 1.5 and Detail WQ-18A for Dry Well design and installation requirements.

Relief Drain – See Figure 10-2 in Appendix M of the Greenville County Stormwater Management Design Manual. The relief drain is designed to not overtop the trench for the 10-yr 24-hr storm event. In large or intense storm events the trench and surrounding soil may become saturated. Select locations for relief drain to follow natural contours to allow surfacing water to sheet flow through a natural landscape.

## 1.3 Design Submittal Request

For land disturbance activities altering the existing contour, grades or slopes, provide the following as a part of the design submittal.

- Existing natural and topographic features.
- Location of all proposed and existing building and streets.
- Location of all water bodies including but not limited to streams, lakes, and wetlands.
- Slopes identified in classes of 0 - 14.9%, 15 – 24.9%, 25 – 33%, and greater than 33% by delineation on a site map.
- Grading plan for the site with a delineation of the disturbed areas.
- A written description of the proposed means and methods used to accomplish slope protection.
- Specific methods which will be utilized to control soil erosion and sedimentation, soil loss and excessive stormwater runoff both during and after construction.
- A statement and description of the stability of the soils on site and the appropriateness of the construction methods proposed.
- A description of the stability of surface patterns of water flows as well as any areas susceptible to slope instability.

## 1.4 IDEAL Modeling

The tables below show how to represent the BMPs discussed in this document in the IDEAL model. It lists the parameters needed to successfully run the model and the parameters that affect the trapping efficiency of the BMP.

| Seepage Cistern Modeling in IDEAL | | |
|---|---|---|
| What to Model as in IDEAL | Cisterns | |
| Similar BMPs | Rooftop and Parking Lot Storage | |
| | Dry Wells | |
| | Rain Barrels | |
| Specifications Needed for IDEAL | Shape and dimensions | |
| | Inlet characteristics: dimensions, slope, head, manning's roughness coefficient, entrance loss coefficient, bend loss coefficient, and the number of bends. | |
| | Orifice diameter and coefficient for gravity drain. | |
| Parameters that Drive Performance | Feature | How Value Affects Sediment Trapping Efficiency (TE) |
| | Volume | Increasing volume increases TE. |
| | Daily Water Use | More use increases storage available and also TE. |