

6.1 Vegetated Swales



Best uses

- Within parking areas
- Adjacent to roadways
- Landscape buffers
- A landscape design element

Advantages

- Can enhance aesthetics
- Potentially inexpensive treatment measure
- Reduced footprint
- Low maintenance

Limitations

- A single swale cannot treat areas greater than 10 acres
- Requires a thick vegetative cover
- Impractical for steep slopes
- Not effective when flow velocity is high
- Not appropriate for industrial activity

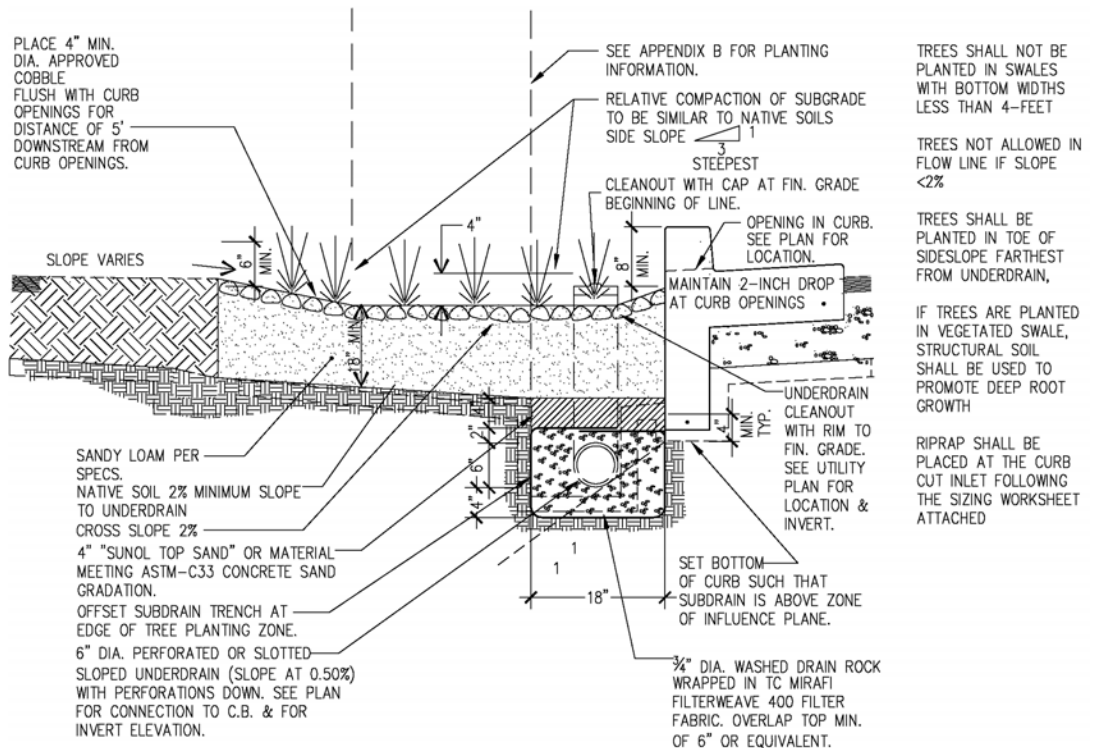
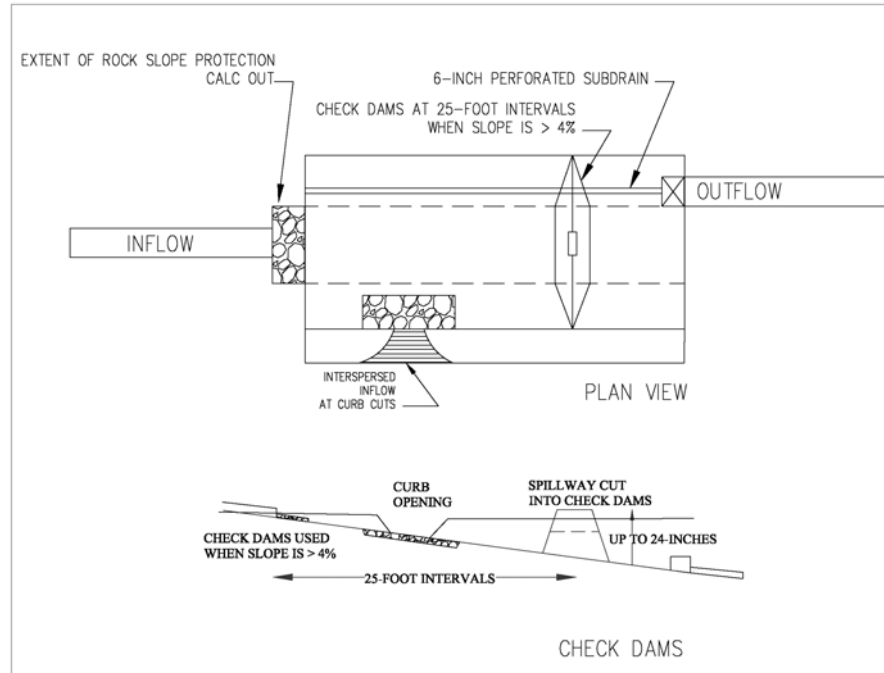
Vegetated swales are open, shallow channels with thick vegetation covering the side slopes and bottom that collect and slowly convey runoff to downstream discharge points. They are designed to treat runoff through sedimentation filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm drain systems.

Design and Sizing Guidelines

TREATMENT DIMENSIONS AND SIZING

- A simplified sizing approach may be used, in which the swale is sized to have a treatment area equal to 4% of the impervious surface area of the site. Alternatively, the swale should meet the treatment standards described below based on maximum flow depth, flow velocity as controlled by maximum slope, and minimum residence time.
- The treatment water depth shall not exceed $\frac{2}{3}$ (two-thirds) the height of the grass or 4 inches, whichever is less, at the design treatment flow rate. Water depth can be assumed to be 2 inches for frequently mowed grass.

- The treatment width of the swale should be determined using Manning's Equation with a value of 0.25 for Manning's "n". The analysis methods for developing flow rates are presented in Section 5.1.
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, may be easier to mow than designs with sharp breaks in slope.



- The longest flow path for the swale shall have a minimum retention time of 12 minutes for conditions when the treatment flows enter the vegetated swale uniformly along the swale length. The longest flow path for the swale shall have a minimum retention time of 8 minutes if 90 percent or more of the treatment flow enters the swale at the upstream end.
- Vegetated swales shall have a maximum treatment width of 10 feet. Parallel swales may be used if calculations show greater width is needed.

STORM DRAIN SYSTEM SIZING

- If the 10- or 100-year storm event flow velocity is greater than 4 feet per second, a permanent geofabric liner shall be used that is rated for the calculated flow velocity.
- For flows greater than the 10-year event, the Manning's Roughness coefficient shall be based on recommendations from Section 2.3 of the Alameda County Flood Control and Water Conservation District, Hydrology and Hydraulics Criteria Summary. The swale shall convey the 10-year storm event with flows contained within the swale. Adjacent to streets, the 100-year storm event shall be conveyed with flows below the top of curb elevation. (Include flow in the gutter in the calculation.)
- If the groundwater table is less than 10 feet deep, an impermeable fabric layer shall be placed below the drain rock to insure against infiltration into perforated underdrain from groundwater.

CONSTRUCTION

- Longitudinal swale slopes should be between 0.5% and 4%, or as specified by the municipality. The overall slope may be up to 8%, slopes between 4 and 8% require check dams up to 24-inches high and at least 25 feet apart to achieve no more than a 4% flow line slope between dams.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- The bed of the Swale flow area shall slope at least 2% from toe of side slope to center of swale. Side slopes shall be no steeper than a 3 to 1 slope.
- A minimum separation of 2-feet will be maintained near a joint trench.

VEGETATION

- See Appendix B for guidance to select a palette of diverse, low-growing plants.
- If vegetation is not established by October 1st, a 1-year biodegradable loose weave geofabric shall be placed on swale surface. If vegetation is not established by October 15th of the year, sod shall be placed over loose soils.
- If trees must be planted in the swale, planting shall occur on side slopes of swale to avoid impeding flows.

INTERFACE WITH PAVED AREAS

- Flow may enter the vegetated swale:
 - As overland flow from landscaping (no special requirements)
 - As overland flow from pavement (cutoff wall required)
 - Through a curb opening
 - Through a curb drain

- With drop structure through a stepped manhole

SOIL CONSIDERATIONS

- No underdrain is needed where native soils are Hydrologic Soil Group A or B
- The perforated underdrain trench shall be backfilled with ¾" drain rock with a 2-inch bed underneath and 6-inch cover. (Caltrans Standard Section 68-1.025 permeable material Class 2) This rock layer shall be separated from the swale using a geofabric covered by a filter layer of sand or fine rock.
- Swale's planting soil shall have a minimum percolation rate of 5 inches/hour and a maximum percolation rate of 10 inches/hour. If native soils do not meet this percolation requirement, an admixture shall be mixed into planting soil to allow for a 5 inch/hour percolation rate. In-situ testing shall be conducted to verify that the material meets the percolation requirements.
- No bark mulch shall be placed in the vegetated swale.
- If import soil is used, it shall have the following properties for sandy loam. A typical soil mix comprises 50% construction sand, 20-30% topsoil with less than 5% maximum clay content and 20-30% organic leaf compost.

MAINTENANCE

- A Maintenance Agreement shall be provided.
- The Maintenance Agreement shall state the parties' responsibility for maintenance and upkeep.
- Mow and irrigate during dry weather to the extent necessary to keep vegetation alive. Where 6-inch high grasses are used, the grass height shall be at least 3 inches after mowing. Where mowed grasses are shown, the grass height shall be mowed when the height exceeds 3 inches.
- Remove obstructions and trash from vegetated swale.
- The use of pesticides and quick-release synthetic fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed. Check with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.
- Vegetated swales shall be inspected and maintained monthly to review:
 - Obstructions and trash.
 - Pondered flow is drained within five days after a rainfall event.
 - Condition of grasses.
 - If ponding is observed, grading will be required to restore positive drainage.
 - If significant sedimentation occurs blocking flows in the swale, sedimentation shall be removed and swale shall be replanted.

