VEGETATED SWALE CALCULATOR (volume-based)

This calculator sizes a vegetated swales or sloped bioretention systems designed to treat the Water Quality Volume (WQv).

Input cell =		User enters value
Default value =		User should only change value if able to provide explanation for adjustment
Calculation cell =		User should not change cell

CALCULATOR

Vegetated Swales Calculator - by Water Quality Volume

1	Water Quality Volume - WQv	2,000	cubic feet
2	Swale Base Width	3	feet (between 2 to 10 feet)
3	Swale Side Slope (Horizontal/Vertical)	3	3:1 or flatter (enter ratio of horizontal to vertical, for example, 3 for 3H:1V)
4	Swale Slope	2.0%	(2% recommended, use check dams to keep slope less than 5%)
5	Ponding Depth above Swale - Pd	1	feet (recommend 0.5 to 1 ft, depth should be equal to check dam height)
6	Check Dam Spacing	50	feet (horizontal spacing between check dams)
	Swale Average Cross-Sectional Area	2.25	square feet
7	Depth of Bioretention Soil Mix - d	1.5	feet (recommend >1.5 ft)
8	Porosity of Bioretention Soil Mix - n	0.35	recommend 0.35
	Hydraulic Conductivity of Bioretention Soil Mix - k	5	in/hr (recommend 5)
9	Fill Time - T	2	hours (0-2 hours, recommend 2)

10	**Length of Swale**	**387**	feet (horizontal length of swale)
11	Freeboard Above WQ Depth	0.20	feet (recommend at least 0.2 ft of freeboard between ponding depth and overflow elevation)
12	Top Width of Swale	10.2	feet
13	**Swale Area**	**3,948**	square feet

14	Infiltration Rate - f	0.50	in/hr (use underdrains if f < 0.5 in/hr)
15	Underdrains Required?	No	Select yes if f < 0.5 or other infiltration constraints apply
16	Time Needed to Infiltrate WQv (no underdrain)	41	hours (if greater than 48 hours, install underdrains)

INSTRUCTIONS

Use the steps below to determine the swale dimensions and length such that the WQv is met by the proposed design.

Step	
1	Enter the Water Quality Volume (WQv) for the drainage management area (DMA). The WQv is calculated in Step 14 of the Water Quality Volume and Water Quality Flow Rate Calculator.
2	Enter the proposed base width of your swale. The sizer assumes the swale is trapezoidal. Base width should be between 2 to 10 feet.
3	Enter the side slope of the swale. The slope of earthen side walls should be no steeper than 3:1 (i.e., at least 3 feet horizontal for each 1 foot vertical). Enter 0 for vertical sidewalls.
4	Enter the longitudinal slope of the swale. The maximum slope for swale design is 5%, and 2% is preferred. Consider using a meandering design, terraces, or check dams to create a satisfactory slope.
5	Enter the ponding depth above the swale. This is typically 6 to 12 inches. The depth should be equal to the check dam height.
6	The spacing between check dams is calculated here based on the swale slope and check dam height.
7	Enter the depth of the bioretention soil mix. This should be greater than 1.5 ft and is generally between 1.5 and 2.5 ft.
8	The default porosity and design hydraulic conductivity of the bioretention soil mix are entered here. The conductivity is based on the bioretention media recommendations provided in the Bioretention Fact Sheet.
9	The default value for fill time for swales is 2 hours.
10	The length of the swale need to capture the WQv is calculated here.
11	Enter the freeboard above the water quality depth. A freeboard of at least 2" is recommended.
12	The overall top width of the swale is calculated here for site layout purposes.
13	The swale area is calculated so that the site area demand can be assessed. The area is based on the water quality depth plus freeboard.
14	Enter the infiltration rate of the underlying soils. This should be determined by geotechnical testing or, for conceptual studies, soil infiltration maps. Enter zero if swale is to be lined.
15	Enter whether underdrains are required at the site. Select "Yes" if underdrains are required due to low infiltration rates or other subsurface constraints, such as depth to groundwater or bedrock.
16	For non-underdrained systems, the time needed to infiltrate the WQv is calculated here. If the drain time is greater than 48 hrs, underdrains should be installed.

DEFINITIONS

Water Quality Volume (WQv)	The runoff volume to be managed by the stormwater BMP such that treatment requirements are met. The WQv is calculated by the Water Quality Volume and Water Quality Flow Rate Calculator.
Infiltration Rate (f)	The rate of water entry into the soil, generally expressed as inches/hour, and determined by geotechnical tests or estimated from soil maps. It equals the hydraulic conductivity of the soil times the hydraulic gradient.
Swale Base Width	The width of the bottom of the swale, when the swale is a trapezoidal shape.
Swale Side Slope	The slope of the sides of the swale, generally expressed as a ratio. The recommended steepest slope is 3:1.
Swale Slope	The longitudinal slope of the swale, this is calculated from your DMA contour survey or similar.
Ponding Depth (Pd)	The depth above the swale surface where runoff is ponded temporarily before filtering through the media.
Depth of Engineered Soil (d)	The depth of the engineered soil beneath the swale.
Hydraulic Conductivity (k)	Measure of the ease in which water moves through a porous media, generally expressed as inches/hour.
Porosity (n)	Volume of void space to total volume. This is expressed as a ratio, e.g. 0.35 means that one cubic foot of gravel contains 0.35 cubic feet of empty space.
Fill Time (T)	The time taken for the water quality storm to fill the swale system.
Swale Length	The length of the swale needed to capture the WQv.
Swale Area	The length of the swale, multiplied by the overall swale width. This describes what area of the site will be occupied by the treatment swale.
Swale Width	The overall width of the swale, including base and side slopes - calculated from a depth equal to the water quality depth plus freeboard.
Drain Time (t)	The time for the storage area to drain the water quality volume.