

Stormwater Treatment Practice (STP) Calculator

Instructions

The [STP Calculator \(https://anrweb.vt.gov/DEC/CleanWaterDashboard/STPCalculator.aspx\)](https://anrweb.vt.gov/DEC/CleanWaterDashboard/STPCalculator.aspx) is a tool developed by the Department of Environmental Conservation (DEC) to estimate total phosphorus load reductions achieved by stormwater treatment practices (STPs). The user enters STP data into the tool and the tool calculates the estimated annual average total phosphorus load reduction. Calculations are based on the same methods DEC will use to track progress reducing phosphorus pollution loading into Lake Champlain and Lake Memphremagog.

Limitations

- The calculator only works to calculate a reduction from a single STP on existing land use. The calculator may not be suited for complex STP systems or projects where an existing STP is being retrofitted. See the **Other Applications** section at the end to how the tool can be applied when an existing STP is being modified.
- The tool can currently only be applied to estimate total phosphorus reductions in the Lake Champlain and Lake Memphremagog watersheds, as pollutant loading rates are currently unavailable outside these basins in Vermont.
- The calculator focuses on STPs treating runoff from developed lands only, and should not be used for agricultural, forested, or other types of land use.
- The STP calculator should only be used for planning purposes to understand pollutant reduction potential for STPs.
- Data entered in the STP calculator will not be stored in a database.
- DEC retains the right to verify the data input and will provide final phosphorus load reduction crediting based on data reported to and stored in DEC's Watershed Projects Database.

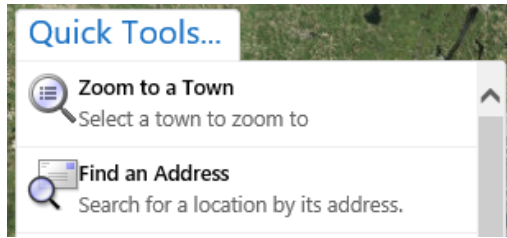
Please direct any questions to Claire.Madden@vermont.gov or 802-636-7536.


Loading Information

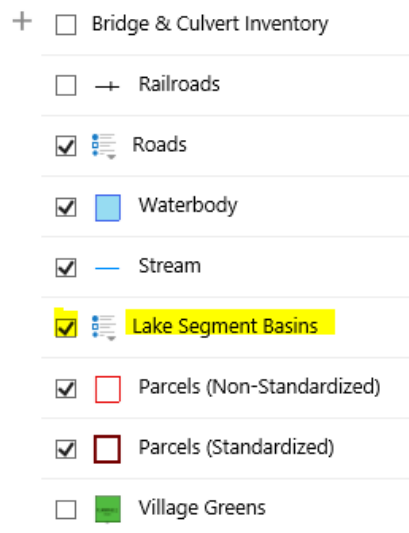
Drainage area

Select the drainage area where the STP is located. Drainage areas are subsections of basins with like-modeled and calibrated pollutant loading rates. Drainage area boundaries can be viewed on the [Natural Resource Atlas](#). The drainage areas in the dropdown menu are based on modeling completed to support the Lake Champlain and Lake Memphremagog phosphorus total maximum daily loads (TMDLs).

1. Navigate to your site by either zooming and panning or use the "Quick Tools" button at the top left of the map to zoom to the town your STP is in or find a specific address.



- Once you have found the location, click the layers tab  at the bottom of the menu on the left. Scroll down on this menu until you see the “Lake Segment Basins” layer and check the box next to it, as shown below.



- The map will display the Lake Segment and the drainage area. In the image below it is “Winooski River.”



Impervious Area (acres)

Enter the acres of impervious surface draining to the practice. Acres should include all types of impervious area (i.e., rooftop, road, gravel, parking lot, driveway, etc.).

Pervious Area (acres)

Enter the acres of pervious surface draining to the practice. Acres should include all types of pervious area (i.e., vegetation, trees, grass, or landscaped areas, etc.).

STP Information

STP Type and Storage Volume

Determine the most appropriate and accurate STP type based on definitions provided. Enter the STP type in the calculator. Calculate the STP storage volume based on the “method for calculating design storage volume” column, below.

STP Type	Description	STP Calculator Type	Method for Calculating Design Storage Volume (DSV)
Infiltration Trench	Provides storage of runoff using the void spaces within the soil/sand/gravel mixture within the trench for infiltration into the surrounding soils.	Infiltration Trench	DSV = void space volumes of stone and sand layers $DSV = (A_{\text{trench}} \times D_{\text{stone}} \times n_{\text{stone}}) + (A_{\text{trench}} \times D_{\text{sand}} \times n_{\text{sand}})$
Subsurface Infiltration	Provides storage of runoff using the combination of storage structures and void spaces within the washed stone within the system for infiltration into the surrounding soils.	Infiltration Trench	DSV = storage volume of storage units and void space of backfill materials. Example for subsurface galleys backfilled with washed stone: $DSV = (L \times W \times D)_{\text{galley}} + (A_{\text{backfill}} \times D_{\text{stone}} \times n_{\text{stone}})$
Surface Infiltration	Provides storage of runoff through surface ponding (e.g., basin or swale) for subsequent infiltration into the underlying soils.	Surface Infiltration	DSV = volume of storage structure before bypass. Example for linear trapezoidal vegetated swale. $DSV = (L \times ((W_{\text{bottom}} + W_{\text{top@Dmax}}) / 2) \times D)$
Rain Garden/ Bioretention (no underdrains)	Provides storage of runoff through surface ponding and possibly void spaces within the soil/sand/washed stone mixture that is used to filter runoff prior to infiltration into underlying soils.	Surface Infiltration	DSV = Ponding water storage volume and void space volumes of soil filter media. Example for raingarden: $DSV = (A_{\text{pond}} \times D_{\text{pond}}) + (A_{\text{soil}} \times D_{\text{soil}} \times n_{\text{soil mix}})$
Rain Garden/ Bioretention (w/underdrain)	Provides storage of runoff by filtering through an engineered soil media. The storage capacity includes void spaces in the filter media and temporary ponding at the surface. After runoff passes through the filter media it discharges through an underdrain pipe.	Bioretention	DSV = Ponding water storage volume and void space volume of soil filter media. $DSV = (A_{\text{bed}} \times D_{\text{ponding}}) + (A_{\text{bed}} \times D_{\text{soil}} \times n_{\text{soil}})$
Gravel Wetland	Provides surface storage of runoff in a wetland cell that is routed to an underlying saturated gravel internal storage reservoir (ISR). Outflow is controlled by an orifice that has its invert elevation equal to the top of the ISR layer and provides retention of at least 24 hours.	Gravel Wetland	DSV = pretreatment volume + ponding volume + void space volume of gravel ISR. $DSV = (A_{\text{pretreatment}} \times D_{\text{pretreatment}}) + (A_{\text{wetland}} \times D_{\text{ponding}}) + (A_{\text{ISR}} \times D_{\text{gravel}} \times n_{\text{gravel}})$
Porous Pavement with infiltration	Provides filtering of runoff through a filter course and temporary storage of runoff within the void spaces of a subsurface gravel reservoir prior to infiltration into subsoils.	Infiltration Trench	DSV = void space volumes of gravel layer $DSV = (A_{\text{pavement}} \times D_{\text{stone}} \times n_{\text{stone}})$

Porous pavement w/ impermeable underlining or underdrain	Provides filtering of runoff through a filter course and temporary storage of runoff within the void spaces prior to discharge by way of an underdrain.	Porous Pavement	Depth of Filter Course = D_{FC}
Sand Filter w/underdrain	Provides filtering of runoff through a sand filter course and temporary storage of runoff through surface ponding and within void spaces of the sand and washed stone layers prior to discharge by way of an underdrain.	Sand Filter	DSV = pretreatment volume + ponding volume + void space volume of sand and washed stone layers. $DSV = (A_{pretreatment} \times D_{preTreatment}) + (A_{bed} \times D_{ponding}) + (A_{bed} \times D_{sand} \times n_{sand}) + (A_{bed} \times D_{stone} \times n_{stone})$
Wet Pond	Provides treatment of runoff through routing through permanent pool.	Wet Pond	DSV= Permanent pool volume prior to high flow bypass $DSV=A_{pond} \times D_{pond}$ (does not include pretreatment volume)
Extended Dry Detention Basin	Provides temporary detention storage for the design storage volume to drain in 24 hours through multiple out let controls.	Dry Pond	DSV= Ponding volume prior to high flow bypass $DSV=A_{pond} \times D_{pond}$ (does not include pretreatment volume)
Grass Conveyance Swale	Conveys runoff through an open channel vegetated with grass. Primary removal mechanism is infiltration.	Grass Swale	DSV = Volume of swale at full design flow $DSV=L_{swale} \times A_{crossect. swale}$
Footnotes:			
DSV= Design Storage Volume = physical storage capacity to hold water			
VSV=Void Space Volume			
L= length, W= width, D= depth at design capacity before bypass, n=porosity fill material, A= average surface area for calculating volume			
Infiltration rate = saturated soil hydraulic conductivity			

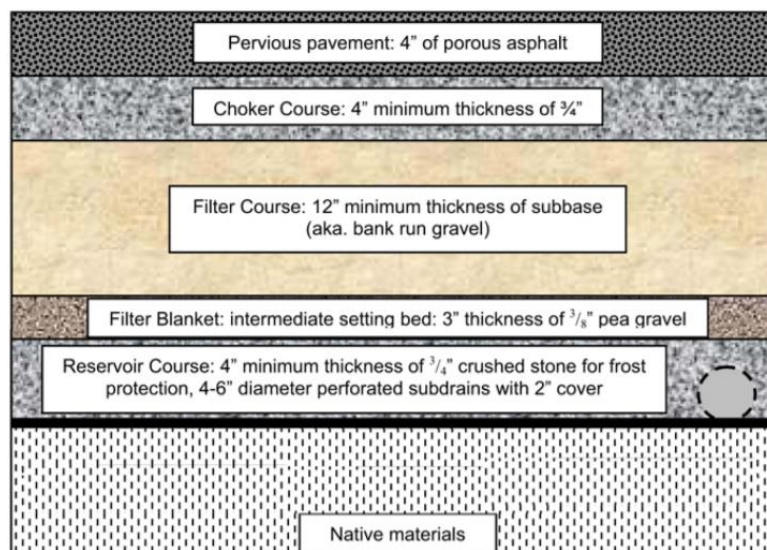
Infiltration Rate

This field will automatically appear when an infiltration STP type is selected. Choose the infiltration rate that most closely matches the infiltration rate, without going over, of the surrounding soils. If you do not know the exact infiltration rate of the surrounding soils this rate can be estimated based on the soil type. Soil type can be estimated using the Hydrologic Soil Group (HSG) layer on the Natural Resources Atlas. Determine the HSG type for the practice site and use the table below to estimate the site's infiltration rate. Note: field verified infiltration rates are necessary to properly design STPs and to accurately estimate pollutant reductions achieved by constructed STPs.

Texture Class	HSG	Infiltration Rate
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Filter Course Depth

This field will automatically appear when the "Porous Pavement with underdrain" STP type is selected. The "Filter Course" component of a porous pavement system includes the depth of the filtering layer. It does not include the depth of pavement itself, nor does it include the gravel reservoir layer. The depth is usually between 12 and 36 inches.



adapted from the University of New Hampshire

Estimated Phosphorus Reduction

Compute Button

The user must select the “Compute” button each time a value is changed to update phosphorus reduction calculations.

Phosphorus Load

This field indicates the modeled total phosphorus load (kilograms per year) coming off the land draining to the STP, before any treatment, based on land use data entered by the user.

STP Capacity

This field indicates the inches of rain runoff (i.e., treatment depth in inches) the STP is capable of treating, based on data entered by the user for storage volume and acres treated by the STP.


Efficiency

This field displays the annual average performance (i.e., efficiency) of the STP in treating total phosphorus, based on the above parameters entered by the user.

Phosphorus Reduction

This field indicates the annual average estimated total phosphorus reduction (kilograms per year) achieved by the STP, based on the above data entered by the user. Note: The user must select the “Compute” button each time a value is changed to update phosphorus reduction calculations.

To Report Button

This button will open a reporting page that will allow the user to export data in the current display to a PDF or other format. At the top of the new page, click the export drop down menu button  and choose a format to export the data to. This could be used as a part of a grant application to show potential P reductions associated with a practice.

Other Applications

The STP Calculator is currently designed to estimate phosphorus reductions from a single STP. If the project involves modifications to an existing STP (Retrofit project) and/or a change in land use, the user will need to perform some additional calculations outside of the tool to estimate the net change in phosphorus loading from the project. Follow the steps and examples below that best fit your project.

1. Calculate the Pre-Project Phosphorus Load – Enter the impervious and pervious area that existed prior to the current project, and the current STP information. Make note of the Phosphorus Load and Phosphorus Reduction.
2. Calculate the Post-Project Phosphorus Load – Enter the impervious and pervious are that will exist on the site after completion of the project. Enter the new STP type and other information. Make note of the Phosphorus Load and Phosphorus Reduction.
3. The resulting phosphorus reduction associated with the project will depend on the situation.

- a. **Change to the STP only:** If an existing STP is being modified as part of the project without any changes to the amount or type of land draining to that STP, then:
 Overall Reduction = Post Project Reduction – Pre Project Reduction

Example 1: Calculating phosphorus reduction where the STP is modified

	Pre-Project	Post-Project
Loading Information		
Drainage Area	Winooski River	Winooski River
Impervious Area	2	2
Pervious Area	3	3
STP Information		
STP Type	Extended Dry Detention Basin	Gravel Wetland
Storage Volume (ft ³)	10,000	12,000
Estimated Phosphorus Reduction		
Load (kg/yr)	2.92	2.92
STP Capacity (inches)	0.97	1.12
Efficiency (%)	11.87	61.97
Reduction (kg/year)	0.35	1.81
Overall Reduction = 1.81 - 0.35 = 1.46 kg/yr		

- b. **Change to the STP AND Change in Drainage Area Size:** In cases where additional existing development will be routed to the STP, the resulting phosphorus reduction is still calculated the same as above.

$$\text{Overall Reduction} = \text{Post Project Reduction} - \text{Pre Project Reduction}$$

Example 2: Calculating phosphorus reduction where the STP changes and the drainage area is increased.

	Pre-Project	Post-Project
Loading Information		
Drainage Area	Winooski River	Winooski River
Impervious Area	2	4
Pervious Area	3	5
STP Information		
STP Type	Wet Pond	Wet Pond
Storage Volume (ft ³)	10,000	25000
Estimated Phosphorus Reduction		
Load (kg/yr)	2.92	5.62
STP Capacity (inches)	0.97	1.21
Efficiency (%)	52.36	55.08
Reduction (kg/year)	1.53	3.1
Overall Reduction = 3.1 – 1.53 = 1.57 kg/yr		

- c. **Change to STP AND Change in Land Use:** In some cases the STP will be modified and the land use is changed, usually by increasing or decreasing the amount of impervious

within the existing drainage area, then the overall phosphorus reduction is calculated by:

$$\text{Overall Reduction} = (\text{Pre Project Load} - \text{Pre Project Reduction}) - (\text{Post Project Load} - \text{Post Project Reduction})$$

Example 3: Phosphorus Reduction when STP and Land Use Changes

	Pre-Project	Post-Project
Loading Information		
Drainage Area	Winooski River	Winooski River
Impervious Area	2	1.5
Pervious Area	3	3.5
STP Information		
STP Type	Extended Dry Detention Basin	Rain Garden/ Bioretention (w/ underdrain)
Storage Volume (ft ³)	10,000	10,000
Estimated Phosphorus Reduction		
Load (kg/yr)	2.92	2.48
STP Capacity (inches)	0.97	1.07
Efficiency (%)	11.87	53.75
Reduction (kg/year)	0.35	1.33
Overall Reduction = (2.92 - 0.35) - (2.48 - 1.33) = 1.42 kg/yr		