

5.8 Pervious Pavers, Porous Concrete, Geogrid System



Pervious pavers, porous concrete, and geo-grid systems are all semi-pervious pavement alternatives to traditional asphalt and concrete. This LID SWMF approach reduces the amount of stormwater runoff by allowing rainwater to infiltrate through it, where traditional pavement allows very little stormwater infiltration. Using this type of material can greatly increase infiltration in areas that would normally contribute to the volume of stormwater that would have to be retained and treated on site. This in turn could potentially bring the impervious surface of your project below the 40% ISR threshold and enable you to qualify for the stormwater management exemption. Pervious pavement, porous concrete, and geo-grid systems are a cost effective approach to reducing the ISR associated with your site. They also work well in tandem with additional LID SWMF techniques.

Advantages:

Installing pervious pavers, porous concrete, and geo-grid systems in areas on your property that would normally be regular concrete or pavement reduces the ISR and reduces stormwater runoff production. The reduction associated with each option is as follows:

- a) Pervious Pavers ISR Reduction Factor => 0.75
- b) Wood Deck ISR Reduction Factor => 0.60
- c) Porous Concrete ISR Reduction Factor => 0.50
- d) Geo-Grid ISR Reduction Factor => 0.25

Example of how to determine the ISR reduction:

- 500 ft² pervious paver driveway would count as (500 ft² x 0.75) 375 ft² impervious area.
- 500 ft² wooden decking would count as (500 ft² x 0.60) 300 ft² impervious area.
- 500 ft² porous concrete driveway would count as (500 ft² x 0.50) 250 ft² impervious area.
- 500 ft² geo-grid driveway would count as (500 ft² x 0.25) 125 ft² impervious area.

Additionally, pervious pavement may increase aesthetic value and can be used in a variety of applications, such as driveways, patios, and sidewalks. It can also have a positive effect with reducing the heat island effect.

Limitations:

This LID SWMF approach can be relatively high maintenance. Edge restraints such as ribbon curb must be installed around the pervious pavement to prevent failure. The surface must be maintained to prevent significant clogging which will negatively impact infiltration rates. This application is not suitable for areas with steep slopes greater

[LOW IMPACT DEVELOPMENT STORMWATER TECHNICAL MANUAL](#)

than 0.5%. Certain pervious pavement surfaces may be difficult to traverse for individuals who have physical disabilities. Void spaces filled with filter material can cause the pavement surface to be uneven and especially difficult for those using crutches, walkers, or high-heeled shoes. Sites subjected to hazardous materials and gasoline are not appropriate for this LID SWMF.

Design Considerations:

- Pervious pavers, porous concrete, and geo-grid materials are a great alternative to traditional paving options in areas that are subject to ponding.
- Pervious pavers are interlocking blocks that have small open areas filled with gravel or natural vegetation.
- Porous concrete and porous asphalt provide a more traditional appearance; both mixes contain small voids that allow water to infiltration through the material and into the ground below.
- Geo-grids are comprised of a continuous plastic grid filled with gravel or natural vegetation.
- All of these applications should be limited to low traffic areas, such as driveways, pool decks, and sidewalks.
- The infiltration rate of the native soil is essential to the function of the pervious pavement system. Compacting the area will reduce the infiltration rate and should be avoided. If the parent soil has been compacted then the soil must be scarified to a minimum depth of 24-inches and re-graded.
- Runoff from adjacent landscaped areas should not be directed onto the pervious pavement system to prevent the system from getting over loaded with pollution and sediment.
- A pretreatment bioswale or grassy filter strip should be established around the pervious pavement, this will allow suspended sediments to settle out of the stormwater prior to entering the area, essentially reducing the frequency of maintenance.
- Porous pavement should be placed over a 2-inch minimum layer of pea gravel followed by a geotextile fabric overlain a minimum 8-inch subbase of well-graded No. 57 gravel (this layer is intended for stabilization and to allow water to infiltrate in to the voids between the gravel).
- Each layer of material should be separated by geotextile fabric designed for stormwater applications.
- The geotextile fabric strips should overlap a minimum of 16-inches and should be secured a minimum of 4-feet beyond the area of the proposed LID SWMF.
- It is always a good idea to install a small 4-inch diameter observation well. The well should be placed within the footprint of the pervious pavement in a location away from vehicle traffic or where it will not become a tripping hazard. The observation well should extend to the bottom of the gravel layer without puncturing the geotextile fabric that is separating the filter media from the native soil. The water will rise in the observation well during a storm event and the property owner will be able to monitor the amount of time it takes water to infiltrate into the soils below. This will allow the owner to gage when maintenance might be necessary.

Design Steps:

1. First determine the required storage volume, soil conditions, depth to the SHGW, and the natural slope of the property at your location using the methods described in **Section 2** and **Section 3**, this will assist you in choosing the optimal location for the LID SWMF.

- The underlying soil may not be compacted. If compaction is unavoidable, the infiltration rates presented in this manual cannot be used for the recovery calculations. In this case, a professional infiltration test will be required to determine the infiltration of the compacted material.
- You will want to keep a minimum of two to four feet separation between the bottom of the pervious pavers and the SHGW. For this example, we will use a depth to SHGW of eight feet.
- Determine the area (dimensions) of the proposed pervious pavement. The design depth of the LID SWMF will be dependent on the proposed area associated with the pervious pavement and the required storage capacity.
- The pervious paver treatment system will have gravel as a subbase, therefore in order to get a representative volume for the capacity of the system, you will need to take into account the average porosity of the gravel media, for this we will use 0.3. Porosity is the ratio of void volume of total volume, in other words it allows us to determine the amount of water that can be stored between the gravel. This means that the gravel takes up approximately 70% or 0.7 of the pervious pavement subbase.
- Determine the required storage volume using the approach presented in **Section 3**, for this example we will use 421 ft³ as the storage requirement. This is based on the volume criteria covered in **Section 3**. Determine the total required volume associated with pervious pavement.

<i>Required Volume of Stormwater to Be Retained (ft³)</i>	<i>Space Allotted for Filter Media (%)</i>	<i>Required Volume of Stormwater to Be Retained (ft³) Porosity</i>	<i>Total Required Volume To Account for Filter Media (ft³)</i>
421 ft ³	70 %	$\frac{421 \text{ ft}^3}{0.3}$	= 1,403 ft ³

From this, we can see that the volume of the system will need to be increased to accommodate the space that the gravel will occupy.

- Determine the total required volume associated with the filter media.

$$\text{Total Required Volume} - \text{Required Water Volume} = \text{Filter Media Volume (ft}^3\text{)}$$

$$1,403 \text{ ft}^3 - 421 \text{ ft}^3 = 982 \text{ ft}^3$$

- Next, determine the available capacity of the proposed area. We will use a standard two-car driveway with a length of 30 feet and a width of 20 feet.

$$\text{Total Area of Driveway (ft}^2\text{)}$$

$$30 \text{ ft} \times 20 \text{ ft} = 600 \text{ ft}^2$$

10. We will determine the depth of the LID SWMF needed to meet the stormwater storage requirements with in the proposed foot print of the driveway.

<i>Total Required Volume (ft³)</i>	=	<i>Depth of Pervious Pavement Sub-base (gravel) (ft)</i>
<hr style="border: none; border-top: 1px solid black;"/>		<hr style="border: none; border-top: 1px solid black;"/>
<hr style="border: none; border-top: 1px solid black;"/>		<hr style="border: none; border-top: 1px solid black;"/>
<i>1,403 ft³</i>		<i>2.33 ft</i>
<i>600 ft²</i>		

11. The depth of the gravel filtration system associated with the pervious pavers will need to be at least 2.33 feet (28 inches).

Refer to Calculation Sheet 5.8 included at the end of this section for assistance in designing a pervious pavement system.

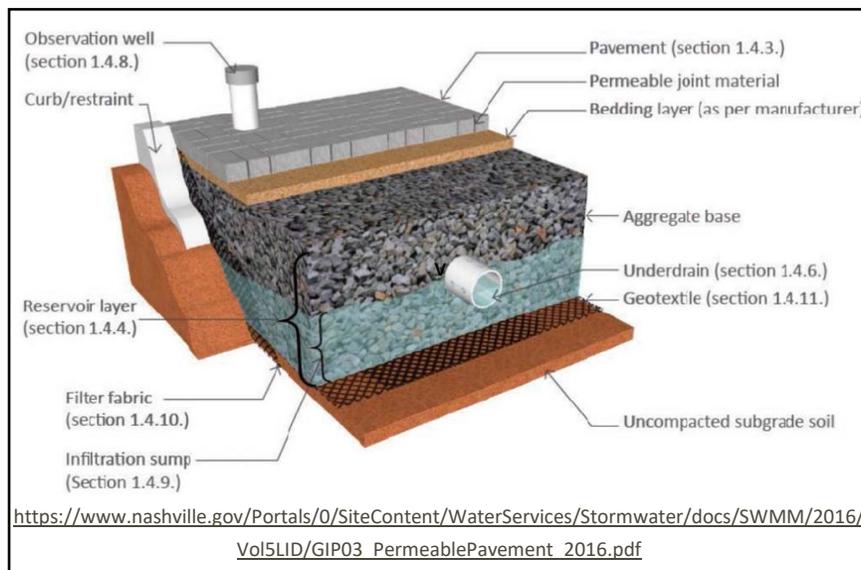
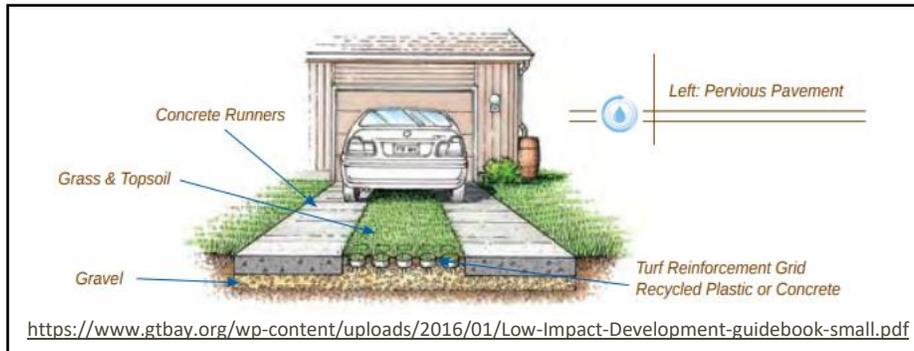
Operation and Maintenance:

Visual inspection should be completed at least quarterly and maintenance should be completed on an as needed basis. The voids between pavers should be inspected for missing aggregate. If any filter material has settled or is missing it should be replenished. The surface of the pervious pavement can become clogged with fine particles and material that must be removed to maintain design infiltration rates. This can be achieved by using a vacuum or regenerative air sweeper. The surface must **not** be pressure washed to remove sediment since pressure washing can force material deeper in to the system where it is difficult to extract, thus permanently reducing infiltration rates. If the system consists of cells filled with vegetation then it must be mowed during the growing season. The mower should be fitted with a bag to collect the clippings.



No pesticide or fertilizer to be applied to this area and within a 10' perimeter.

Pervious Pavement Examples:



Maintenance Form 5.8 – Pervious Pavement:

Pervious Pavement LID SWMF		
Owner:		
Address:		
Phone:		
E-mail:		
Parcel Number:		
Date of Last Inspection:		
- Please attach pictures		
List any additional LID SWMF on site:		
List any previous concerns:		
Inspection List	Yes	No
Does water drain freely through the system?	<input type="checkbox"/>	<input type="checkbox"/>
Are there any areas with prolonged standing water on or around the pavement?	<input type="checkbox"/>	<input type="checkbox"/>
Is there a buildup of sediment on or around the pavement?	<input type="checkbox"/>	<input type="checkbox"/>
Is the system over flowing?	<input type="checkbox"/>	<input type="checkbox"/>
Are sediment basins clean and clear from buildup (if applicable)?	<input type="checkbox"/>	<input type="checkbox"/>
Has soil settled or eroded around the pavement?	<input type="checkbox"/>	<input type="checkbox"/>
Has there been any soil compaction within the area?	<input type="checkbox"/>	<input type="checkbox"/>
Last time sediment was removed from the system.		
Maintenance Items To be Completed:		
By signing this form, I certify that I have inspected this system.		
Owners Signature	Date	

Calculation Sheet 5.8 – Pervious Pavement Design:

Only Enter Information In To The Green Boxes - All Other Boxes Are Automatically Calculated

Low Impact Development Calculation Sheet			
Owner			Line 1
Address			Line 2
Phone			Line 3
E-mail			Line 4
Parcel Identification Number			Line 5
Total Proposed Disturbed Area	_____ ac		Line 6
Proposed Impervious Area Totals			
House	_____	ft ²	Line 7
Detached Garage	_____	ft ²	Line 8
Shed	_____	ft ²	Line 9
Driveway	_____	ft ²	Line 10
Patio / Porch / Deck	_____	ft ²	Line 11
Pool	_____	ft ²	Line 12
Misc Description:	_____	ft ²	Line 13
Is Your Property In The Following Locations:			
		Yes	No
ICPAL	If "yes" see section 3.4	<input type="checkbox"/>	<input type="checkbox"/>
Dune Lake	If "yes" see section 3.5	<input type="checkbox"/>	<input type="checkbox"/>
Near a Mosquito Control Ditch	If "yes" see section 3.6	<input type="checkbox"/>	<input type="checkbox"/>
Area Totals			
Total Impervious Area	_____	ft ²	Line 14
Total Impervious Area (acres)	_____	ac	Line 15
Total Impervious Area (acres)	= Total Area (ft ²) * (1 acre/ 43,560 ft ²)		
Total Pervious Area	_____	ac	Line 16
Total Pervious Area (ft ²)	_____	ft ²	Line 17
Total Pervious Area (acres) = Total Area (acres) - Total Impervious Area (acres)			
Next Determine the Volume Required Per the LDC Section 5.06.00			
Total Property (square feet)	_____	ft ²	Line 18

Soils Characteristics			
Depth to Seasonal High Groundwater Table	<input style="width: 100%;" type="text"/>	ft below ground surface	Line 19
Predominant Soil Type			
Predominant Soil Type	<input style="width: 100%;" type="text"/>	Value Taken From USGS Soils Survey	Line 20
Infiltration Actual K_{sat}	<input style="width: 100%;" type="text"/>	in/hr Provided in Table 3	Line 21
Design Infiltration Design K_{sat}	<input style="width: 100%;" type="text"/>	in/hr	Line 22

Stormwater Volume Requirements			
<input style="width: 100%;" type="text"/> 0.5 in Rainfall Over Disturbed Area	<input style="width: 100%;" type="text"/>	ft^3	Line 23
<input style="width: 100%;" type="text"/> 1 in Runoff Over Proposed Impervious Surface	<input style="width: 100%;" type="text"/>	ft^3	Line 24
Attenuation Volume	<input style="width: 100%;" type="text"/>	ft^3	Line 25
Required Retention Volume	<input style="width: 100%;" type="text"/>	ft^3	Line 26
Find Largest Value Between Line 23, 24, and 25 And Enter The Value On Line 26			

*****Special Circumstances Only - Verify Your Location****

Section 3.4 Stormwater Volume Requirements for ICPAL			
<input style="width: 100%;" type="text"/> 0.5 in Rainfall Over Disturbed Area	<input style="width: 100%;" type="text"/>	ft^3	Line 27
<input style="width: 100%;" type="text"/> 1 in Runoff Over Proposed Impervious Surface	<input style="width: 100%;" type="text"/>	ft^3	Line 28
Attenuation Volume	<input style="width: 100%;" type="text"/>	ft^3	Line 29
Required Retention Volume	<input style="width: 100%;" type="text"/>	ft^3	Line 30
Find Largest Value Between Line 27, 28, and 29 And Enter The Value On Line 30			

Section 3.5 Stormwater Volume Requirements for Dune Lake			
<input style="width: 100%;" type="text"/> 0.5 in Rainfall Over Disturbed Area	<input style="width: 100%;" type="text"/>	ft^3	Line 31
<input style="width: 100%;" type="text"/> 1 in Runoff Over Proposed Impervious Surface	<input style="width: 100%;" type="text"/>	ft^3	Line 32
Attenuation Volume	<input style="width: 100%;" type="text"/>	ft^3	Line 33
Required Retention Volume	<input style="width: 100%;" type="text"/>	ft^3	Line 34
Find Largest Value Between Line 31, 32, and 33 And Enter The Value On Line 34			

Section 3.6 Stormwater Volume Requirements for Mosquito Control Ditch			
<input style="width: 100%;" type="text"/> 0.5 in Rainfall Over Disturbed Area	<input style="width: 100%;" type="text"/>	ft^3	Line 35
<input style="width: 100%;" type="text"/> 1 in Runoff Over Proposed Impervious Surface	<input style="width: 100%;" type="text"/>	ft^3	Line 36
Attenuation Volume	<input style="width: 100%;" type="text"/>	ft^3	Line 37
Required Retention Volume	<input style="width: 100%;" type="text"/>	ft^3	Line 38
Find Largest Value Between Line 35, 36, and 37 And Enter The Value On Line 38			

Table 3. NRCS Soil Data

Map Unit Symbol	Map Unit Name	HSG	SHGW Elevation (SHGW)	High Water Season	Permeability Rate (Ksat)
5	Chiple sand, 5 to 8 % slopes	A	-2 feet	Dec - Apr	6 in/hr
8	Dorovan-Pamlico association, frequently flooded	B/D	0 (at surface)	Jan – Dec	0.6 in/hr
12	Foxworth sand, 0 to 5 percent slopes	A	-3.5 feet	Jun – Oct	20 in/hr
16	Kureb sand, 0 to 8 percent slopes	A	-5 feet	----	6 in/hr
17	Lakeland sand, 0 to 5 percent slopes	A	-5 feet	----	6 in/hr
18	Lakeland sand, 5 to 12 percent slopes	A	-5 feet	----	6 in/hr
19	Lakeland sand, 12 to 30 percent slopes	A	-5 feet	----	6 in/hr
21	Leon sand, 0 to 2 percent slopes	A/D	0 (at surface)	Jun – Feb	0.6 in/hr
27	Rutlege fine sand, 0 to 2 percent slopes	A/D	0 (at surface)	Dec – May	6 in/hr
30	Tifton fine sandy loam, 5 to 8 percent slopes	B	-3.5 feet	Jan – Feb	0.6 in/hr
36	Pits	-	On-site test	On-site test	On-site test
45	Dirego muck, frequently flooded	A/D	0 (at surface)	Jan – Dec	6 in/hr
49	Eglin sand, 0 to 5 percent slopes	A	-5 feet	----	6 in/hr
50	Mandarin sand, 0 to 2 percent slopes	A	-1.5 feet	Jun – Dec	0.6 in/hr
51	Bigbee loamy sand, 0 to 5 percent slopes, occasionally flooded	A	-3.5 feet	Jan – Mar	6 in/hr
53	Arents, 2 to 8 percent slopes	A	-5 feet	----	20 in/hr
54	Newhan-Corolla sands, rolling	A	-5 feet	----	20 in/hr
55	Beaches	-	0 (at surface)	----	0 in/hr
56	Kureb sand, hilly	A	-5 feet	----	6 in/hr
57	Hurricane sand, 0 to 5 percent slopes	A/D	-2 feet	Nov – Apr	6 in/hr
58	Duckston muck, frequently flooded	A/D	0 (at surface)	Jan – Dec	6 in/hr
62	Resota sand, 0 to 5 percent slopes	A	-3.5 feet	Dec – Apr	20 in/hr
63	Pickney sand, depressional	A/D	0 (at surface)	Nov – Apr	6 in/hr
64	Pamlico muck	A/D	0 (at surface)	Dec – May	0.6 in/hr
69	Floralo loamy fine sand, 2 to 5 percent slopes	C	-1.5 feet	Dec – Mar	0.06 in/hr
99	Water	-	-	-	-
100	Waters of Gulf of Mexico	-	-	-	-

Site Characteristics		
Total Disturbed Area	_____ ft ²	Line 1
Impervious Area	_____ ft ²	Line 2
Impervious Surface Ratio (ISR)	_____	Line 3
Soil Characteristics		
Soil Type - Refer to Section 2.4		Line 4
Rainfall Intensity	_____ 0.43 in/hr	Line 5
Infiltration Rate - Refer to Table 3	_____ in/hr	Line 6
Design Infiltration Rate (Divide By 2)	_____ in/hr	Line 7
Rainfall Depth	_____ 8.73 in	Line 8
Reduced Rainfall Depth	_____ in	Line 9
Attenuation Calculation		
Design Factor - Choose One Based On The ISR Calculated In Line 3	_____	Line 10
ISR Less Than 0.4	1	
ISR Between 0.4 and 0.7	1.2	
ISR Greater Than 0.7	1.4	
Design Rainfall Depth	_____ in	Line 11
Design Rainfall Depth (Conversion)	_____ ft	Line 12
Required Storage Volume	_____ ft ³	Line 13

Site Characteristics

Total Disturbed Area	_____ ft ²	Line 1
Impervious Area	_____ ft ²	Line 2
Impervious Surface Ratio (ISR)	_____	Line 3

Soil Characteristics

Soil Type - Refer to Section 2.4		Line 4
Rainfall Intensity	_____ 0.61 in/hr	Line 5
Infiltration Rate - Refer to Table 3	_____ in/hr	Line 6
Design Infiltration Rate (Divide By 2)	_____ in/hr	Line 7
Rainfall Depth	_____ 14.7 in	Line 8
Reduced Rainfall Depth	_____ in	Line 9

Attenuation Calculation

Design Factor - Choose One Based On The ISR Calculated In Line 3	_____	Line 10
ISR Less Than 0.4	1	
ISR Between 0.4 and 0.7	1.2	
ISR Greater Than 0.7	1.4	
Design Rainfall Depth	_____ in	Line 11
Design Rainfall Depth (Conversion)	_____ ft	Line 12
Required Storage Volume	_____ ft ³	Line 13

*****Only Enter Information In To The Green Boxes - All Other Boxes Are Automatically Calculated*****

Site Characteristics

Total Disturbed Area	<input type="text"/>	ft ²	Line 1
Depth To SHGW	<input type="text"/>	ft	Line 2
Infiltration	<input type="text"/>	in/hr	Line 3

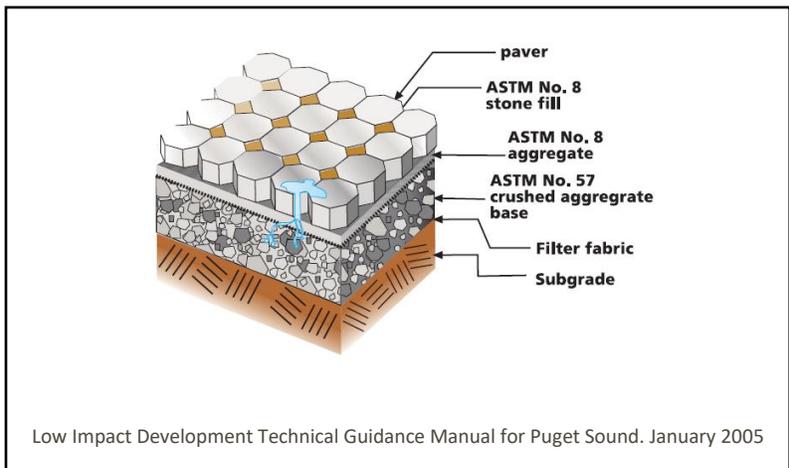
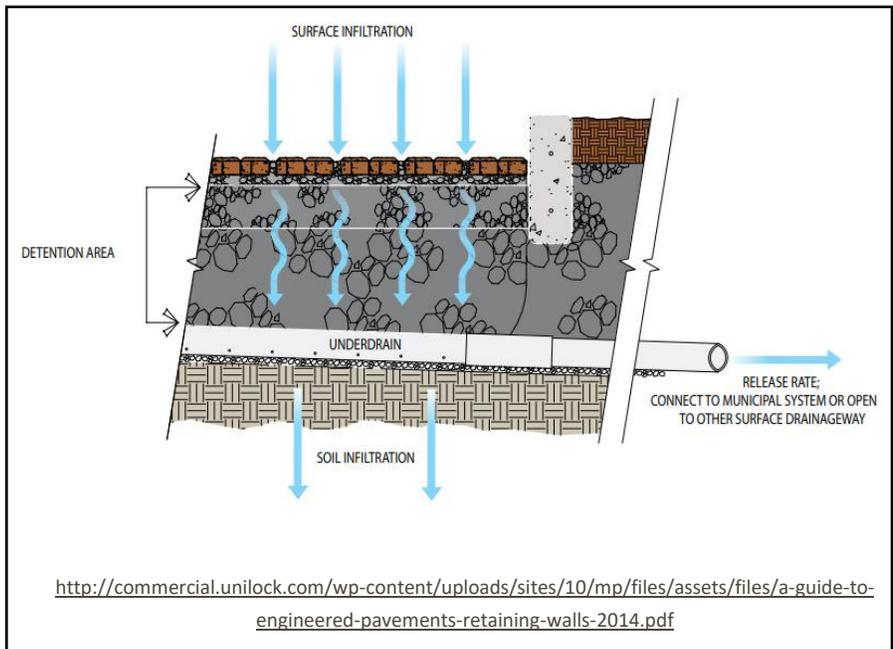
Treatment Volumes

Design Volume (largest value from Site Characteristics sheet)	<input type="text"/>	ft ³	Line 4
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Pervious Pavement Design

Additional Volume Requirement	<input type="text"/>	ft ³	Line 5
Total Required Volume of Infiltration Trench	<input type="text"/>	ft ³	Line 6
Length Allotted for Pervious Pavement	<input type="text"/>	ft	Line 7
Width Allotted for Pervious Pavement	<input type="text"/>	ft	Line 8
Area Allotted for Pervious Pavement	<input type="text"/>	ft ²	Line 9
Required Filter Media Depth	<input type="text"/>	ft	Line 10
	<input type="text"/>	in	Line 11
Recovery Time	<input type="text"/>	hr	Line 12





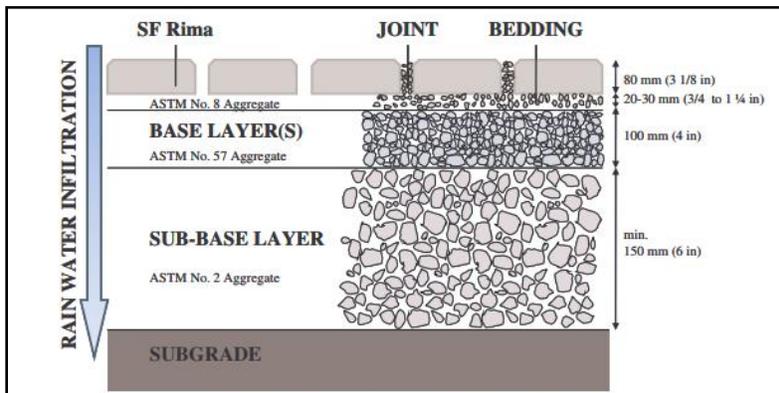


Figure 3. Typical Cross-Section and Materials

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