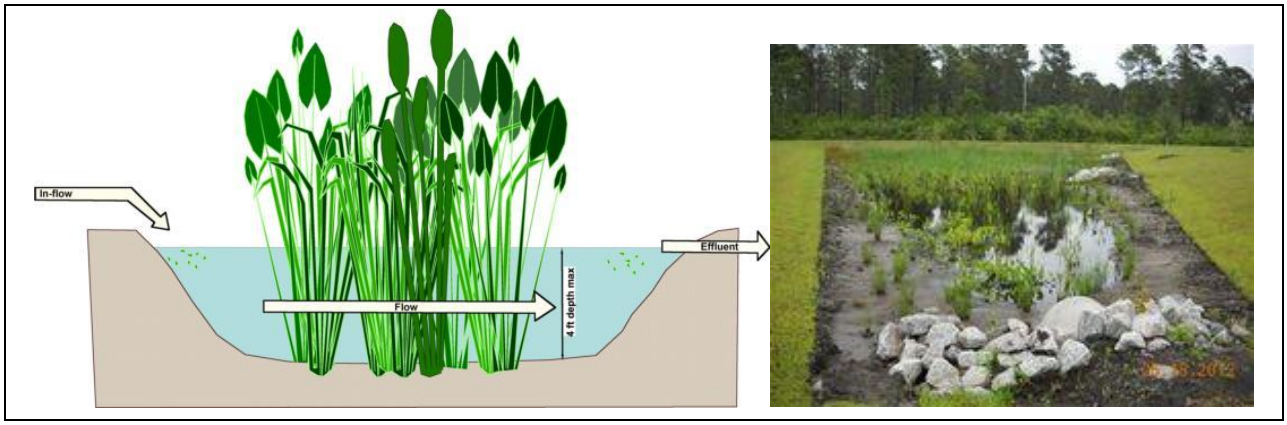
5.7 Pocket Wetlands



Pocket wetlands are constructed shallow marsh systems designed to control stormwater volume and facilitate pollutant removal. Pocket wetlands have less biodiversity than natural wetlands but still require a base flow to support aquatic vegetation. Pollutant removal in these systems occurs through the settling of larger solids and course organic material and by uptake by the aquatic vegetation. Pocket wetlands are designed with three distinct zones: a forebay immediately after the inlet, the wetland area, and a micropool immediately prior to the outfall, as wells, randomly dispersed throughout the system. The forebay and micropool allow for sediment control. They are similar in concept to a rain garden and enhanced shallow swale with the exception that they retain water and are the deepest portions of the pocket wetland.

important **No fertilizer or pesticides can be applied to the pocket wetland and its 10-foot perimeter.**

Advantages:

Pocket wetlands effectively mimic the complex biological, chemical, and physical processes that take place in naturally formed wetlands. Improving water quality is a primary focus of pocket wetland design. Settling and vegetative uptake are the primary mechanisms of pollutant removal associated with this approach. Pocket wetlands are suitable for locations with HSG classification C and D, where the SHGW table is two feet or less below the ground surface. This LID SWMF generally presents a low maintenance solution. They offer a great way to integrate the natural beauty of water into a vast array of landscaping opportunities.

Additionally, they can act as temporary storage during extreme storm events and enhance the natural ecological variations that Northwest Florida has to offer. Increasing the duration of discharge and controlling stormwater volume enables pocket wetlands to significantly reduce peak discharge. Detaining and extending runoff times reduces the total energy of the storm event. Hydraulic detention of stormwater is achieved through sporadic increases in the water depth throughout the wetland. A continuous base flow should be available to the wetlands to keep the area from drying out or becoming stagnant.

Limitations:

Pocket wetlands require more area than other LID SWMF options; therefore, they are not a suitable choice for areas with limited space. Maintenance can be time intensive if exotic species are allowed to dominate the system,

therefore they should be eradicated on a regular basis. Pocket wetlands should be established in an area that will have a continuous base flow; otherwise, the wetland will become stagnant and promote mosquitos. Initial construction cost may be higher than other LID SWMF options depending on if excavation is necessary to maintain a permanent pool elevation. The permanent pool elevation should be established and maintained to at least the SHGW.

Design Considerations:

- Pocket wetlands are comprised of several varying water depths. Each section has a specific purpose, such as settlement and filtration. A general rule of thumb is to allocate a minimum of 1% of the contributing drainage area as the starting point for the surface area of the wetland; however, 3% to 5% is optimal.
- The optimal length to width ratio should be 2:1.
- Approximately 25% of the pocket wetland area should have a depth of 6 inches or less, this area is known as the banks or transition zones.
- 55% of the pocket wetlands should be no more than 18 inches; this is known as the main channel.
- This leaves approximately 20% reserved for deeper pools, one near the inlet (forbay), one near the outlet (micropool), and several others randomly established throughout the system (deep pools). The deeper portions slow down water, collect sediment, and provide a safe area for aquatic plants and species to thrive during times of drought.
- Pretreatment of stormwater prior to its introduction into the wetland should be integrated into the layout to prevent extreme sediment loading. Pretreatment options include filter strips, swales, and catch basins. Oil and grit separators are recommended if the water has traveled over paved areas such as roads or driveways.
- A soil enhancement plan should be generated along with a landscape and maintenance plan. Soils for the pocket wetland should be a mix of impermeable and permeable soils. This will allow slower infiltration rates normally desired in alternative LID SWMF.
- The pocket wetlands should have a minimum 50% vegetative coverage established in the wetland zone by the end of the second growing season.
- Incoming water should be a steady tranquil flow to mitigate erosion and sediment transport. This can be achieved by placing geotextile fabric with riprap over top. This will slow the water down and allow some of the suspended sand and silt to settle out of the water prior to entering the pocket wetlands.
- If the HGS classification is A or B or the depth the SHGW is greater than two feet, then a liner or clay layer may be used to retain the necessary water depth throughout the pond. The infiltration rate of the liner or clay layer should be less than 0.01 in/hr.
- Compaction of the soil within the footprint of the pocket wetlands may be necessary.
- The elevation difference between the inflow and the outflow should be between 2 to 5 feet.

Design Variations

Several design variations exist for pocket wetlands, with the differences occurring in the amount of storage volume provided, pond depth, and dry storage. While other design variations exist including shallow wetlands, extended detention shallow wetlands, and pond/wetland systems, only pocket wetlands have a realistic application in urban environments. The other design variations require a larger drainage area to sustain wetland water levels.

Design Steps:

1. First determine the storage treatment 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.

2. Determine the required storage volume using the approach presented in **Section 3**, for this example we will use 842 ft^3 as the storage requirement. This is based on the wet detention criteria covered in **Section 3**.

3. Determine the dimensions of the pocket wetland. For this example, we will use the following information: depth to SHGW is 1 feet, the design depth will vary between 18 inches and 6 inches with a few deeper portions that will extend into the SHGW. Using this data, we will determine the required area of the pocket wetland. The optimal length to width ratio should be maintained at 2:1. Approximately 25% of the wetland area should have a depth of 6 inches or less, 55% should be no more than 18 inches, and the remaining 20% will be reserved for deeper portions near the inlet and outlet.

4. The pocket wetland will have vegetation distributed throughout, therefore in order to get a representative volume for the capacity you will need to increase the total volume by 60% (or 0.6).

Required Volume of Stormwater to Be Retained (ft^3)	***Space Allotted for Filter Media (%)***	***Required Volume of Stormwater to Be Retained (ft^3) / Porosity of Soil***	***Total Required Volume (ft^3)***
842 ft^3	*60 %*	*$\frac{842\ ft^3}{0.4}$*	*= 2,105 ft^3*

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

Total Required Volume - Required Water Volume = Filter Media Volume (ft^3)
2,105 ft^3 - 842 ft^3 = 1,263 ft^3

6. Determine the volumes associated with the 6-inch depth and the area associated with the 18-inch depth.

Required Volume of Pocket Wetlands (ft^3)	***Optimum Area Associated With 6 " depth***	***6" Wetland Volume (ft^3)***
2,105 ft^3	*0.25*	*2,105 ft^3 x 0.25 = 526 ft^3*

Required Volume of Pocket Wetlands (ft^3)	***Optimum Area Associated With 18 " depth***	***18" Wetland Volume (ft^3)***
2,105 ft^3	*0.55*	*2,105 ft^3 x 0.55 = 1,158 ft^3*

7. The remaining volume will be reserved for the deep portions of the system:

Required Volume of Pocket Wetlands (ft^3)	*- 18" Deep Wetland Volume (ft^3)*	*- 6" Deep Wetland Volume (ft^3)*	*= 3 ft Deep Wetland Volume (ft^3)*
$2{,}105\ ft^3$	$-\ 1{,}158\ ft^3$	$-\ 526\ ft^3$	$=\ 421\ ft^3$

8. Next, we will determine the required area associate with each depth. For simplicity, we will neglect the capacity of the side slopes.

Convert 6" Depth From Inches to Feet		
$6\ in\ *$	$\frac{1\ ft}{12\ in}$	$= 0.5\ ft$

Required 6" Deep Wetland Volume (ft^3) / Depth (ft)	*= 6" Deep Wetland Area (ft^2)*
$\frac{526\ ft^3}{0.5\ ft}$	$= 1{,}052\ ft^2$

9. Now that we know the area we need for the shallow 6-inch deep portion, we can determine the length and width. This will depend on site characteristics. For this example we will allocate a width of 14 feet for the pocket wetland, keep in mind we are not taking into account the side slopes therefore the actual width of the pocket wetlands will be slightly greater than 14 feet. Now that we have a proposed width, we can calculate the length that will be required for us to meet the required storage capacity.

We will use a width of 5 feet for the 6" deep portion; this allocates three feet of shallow area on each side of the pocket wetland.

6" Deep Wetland Area (ft^2) / Width (ft)	*= 6" Deep Wetland Length (ft)*
$\frac{1{,}052\ ft^2}{5\ ft}$	$=2{,}104\ ft$

10. Divide this value in half to account for each side of the pocket wetlands.

$$\frac{\text{6" Deep Wetland Length (ft)}}{2} = \text{Length of 6" Deep Wetland for Each Side (ft)}$$

$$\frac{210\ ft}{2} = 105\ ft$$

11. Follow the same approach to determine the dimensions for the 18-inch deep portion of the pocket wetlands.

Convert 18" Design Depth From Inches to Feet

$$18\ in * \frac{1\ ft}{12\ in} = 1.5\ ft$$

$$\frac{\text{Required 18" Deep Wetland Volume } (ft^3)}{\text{Depth (ft)}} = \text{18" Deep Wetland Area } (ft^2)$$

$$\frac{1{,}158\ ft^3}{1.5\ ft} = 772\ ft^2$$

12. Since we are proposing a total width of 14 feet for the pocket wetland, we will allocate 5 feet to the portion with a depth of 18 inches (the edges of the pocket wetland will gradually transition from 18 inches to 6 inches). Now that we have the proposed width of the 18 inch deep portion we can calculate the length that will be required for us to meet the required storage capacity.

$$\frac{\text{18" Deep Wetland Area } (ft^2)}{\text{Width (ft)}} = \text{18" Deep Wetland Length (ft)}$$

$$\frac{772\ ft^2}{5\ ft} = 154\ ft$$

13. Follow the same approach to determine the dimensions for the 3-foot deep portion of the pocket wetlands.

$$\frac{\text{Required 3' Deep Wetland Volume } (ft^3)}{\text{Depth (ft)}} = \text{3' Deep Wetland Area } (ft^2)$$

$$\frac{421\ ft^3}{3\ ft} = 140\ ft^2$$

14. We will propose a width of 5 feet for the pocket wetland in the deepest area (the edges of the pocket wetland will gradually transition from 3 feet to 18 inches and so on). Now that we have the proposed width we can calculate the length that will be required for us to meet the required storage capacity.

3' Deep Wetland Area (ft^2) / ***Width (ft)***	***= 3' Deep Wetland Length (ft)***
$\frac{140\ ft^2}{5\ ft}$	*= 28 ft*

Based on these calculations, we need to construct a pocket wetland with the following minimum dimensions:

- **Wetland Banks and transition zones**: 6-inch deep, total 105 linear feet to include perimeter and transition zones, 2.5 foot wide;
- **Wetland Channels**: 18-inch deep, 154-foot meandering channel, 5-foot wide;
- **Wetland Forebay (inlet pool), Micropool (outlet pool), Deep Pools**: 3-foot deep, 5-foot wide, total of 28 linear feet dispersed sections (one on each end and a few dispersed throughout the main channel).
- The deeper portion of the pocket wetlands should be constructed to meander through the shallow portions, as well as a portion near the inlet (forebay) and a portion near the outlet.

The layout of the meandering channels and deeper pools presents room for creativity. Some people even go so far as to build observation decking and platforms around the area.

15. Next, determine the recovery time.

Recovery Time	***Depth of LID SWMF (in)*** / ***0.5*Permeability (in/hr)***	***= Hours***
Recovery Time For Clay Soils (Wet Swale with Poorly Drained Soils)	*18 in* / *0.5 * 0.6 (in/hr)*	*= 60 hr < 72 hr*

The recovery time is less than 72-hours, therefore it is acceptable.

Refer to Calculation Sheet 5.7 included at the end of this section for assistance with designing pocket wetlands.

Operation and Maintenance:

The following inspection items should be completed after larger storm events, as well as, on an annual basis:

- Inspect vegetation to evaluate overall health and abundancy. Eradicate invasive species and identify any potential problems with vectors, such as mosquitoes. If mosquitoes are present, natural mosquito control should be employed. DO NOT USE pesticides or herbicides to the area; the addition of synthetic chemicals has a negative impact on receiving waters downstream from the pocket wetlands.
- Check for sedimentation periodically. Remove sediments deposited in any portion of the LID SWMF as necessary in order to maintain the design capacity of the system.

The following maintenance steps should be performed as needed:

- Trim overgrown vegetation.
- Remove and replace any dead or severely damaged vegetation.
- Remove sediment, trash, and debris as needed.
- Stabilize any upstream erosion as needed.

Maintenance Form 5.7 – Pocket Wetlands:

Pocket Wetlands 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 - Please attach pictures	Yes	No
Does water move freely through the system?	☐	☐
Are there any areas with prolonged standing water?	☐	☐
Is the vegetation thriving?	☐	☐
Are there any areas with stressed or dying plants?	☐	☐
Are they any invasive species in the wetland?	☐	☐
Is there an excess of plant debris in the wetland?	☐	☐
Is there a buildup of sediment in the area?	☐	☐
Is there evidence of erosion?	☐	☐
Is the system over flowing?	☐	☐
Are sediment basins clean and clear from build up?	☐	☐
Last time rip rap was replenished (if applicable).		

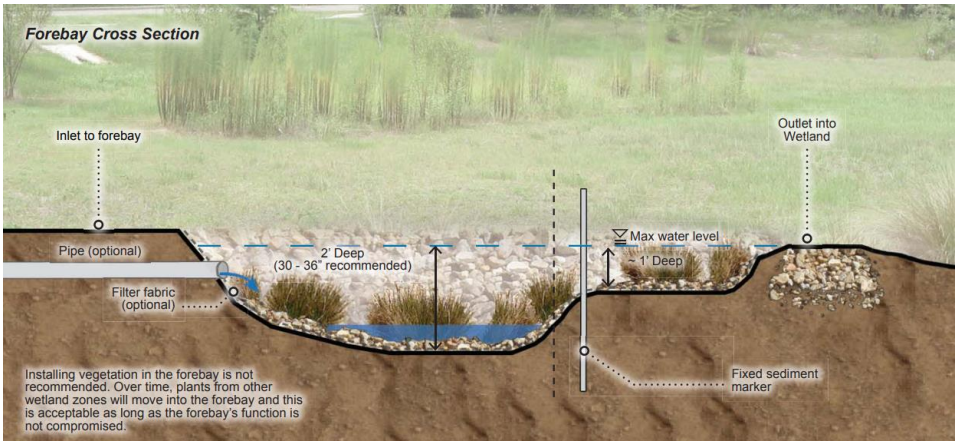
Maintenance Items To be Completed:

By signing this form, I certify that I have inspected this system.

_____

Owners Signature **Date**

Pocket Wetland Examples:



http://www.adem.state.al.us/programs/water/waterforms/LIDHandbook.pdf

http://www.roads.maryland.gov/m/index.aspx?PageId=119

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Calculation Sheet 5.7 – Pocket Wetland 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	☐	☐
Dune Lake	If "yes" see section 3.5	☐	☐
Near a Mosquito Control Ditch	If "yes" see section 3.6	☐	☐

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			ft below ground surface	Line 19

Predominant Soil Type

Predominant Soil Type				Value Taken From USGS Soils Survey	Line 20
Infiltration	Actual K_{sat}		in/hr	Provided in Table 3	Line 21
Design Infiltration	Design K_{sat}		in/hr		Line 22

Stormwater Volume Requirements

1 in Runoff Over Proposed Impervious Surface		ft^3		Line 23
1 in Runoff Over Proposed Impervious Surface		ft^3		Line 24
Attenuation Volume		ft^3	Find Largest Value Between Line 23, 24, and 25 And Enter The Value On Line 26	Line 25
Required Retention Volume		ft^3		Line 26

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

Section 3.4 Stormwater Volume Requirements for ICPAL

1 in Runoff Over Proposed Impervious Surface		ft^3		Line 27
1 in Runoff Over Proposed Impervious Surface		ft^3		Line 28
Attenuation Volume		ft^3	Find Largest Value Between Line 27, 28, and 29 And Enter The Value On Line 30	Line 29
Required Retention Volume		ft^3		Line 30

Section 3.5 Stormwater Volume Requirements for Dune Lake

1 in Runoff Over Proposed Impervious Surface		ft^3		Line 31
1 in Runoff Over Proposed Impervious Surface		ft^3		Line 32
Attenuation Volume		ft^3	Find Largest Value Between Line 31, 32, and 33 And Enter The Value On Line 34	Line 33
Required Retention Volume		ft^3		Line 34

Section 3.6 Stormwater Volume Requirements for Mosquito Control Ditch

1 in Runoff Over Proposed Impervious Surface		ft^3		Line 35
1 in Runoff Over Proposed Impervious Surface		ft^3		Line 36
Attenuation Volume		ft^3	Find Largest Value Between Line 35, 36, and 37 And Enter The Value On Line 38	Line 37
Required Retention Volume		ft^3		Line 38

Table 3. NRCS Soil Data

Map Unit Symbol	Map Unit Name	HSG	SHGW Elevation (SHGW)	High Water Season	Permeability Rate (Ksat)
5	Chipley 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	Florala 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		ft^2	Line 1
Depth To SHGW		ft	Line 2
Infiltration		in/hr	Line 3

Treatment Volumes

Design Volume (largest value from Site Characteristics sheet)		ft^3	Line 4

Pocket Wetland Design - Single LID Application

Additional Volume Requirement		ft^3	Line 5
Total Required Volume of Pocket Wetlands		ft^3	Line 6
Wetland Volume in Relation To Depths			
Volume Associated With 6 Inch Depth		ft^3	Line 7
Volume Associated With 18 Inch Depth		ft^3	Line 8
Volume Associated With 3 ft Depth		ft^3	Line 9
Area Required For Each Depth			
Area Associated With 6 Inch Depth		ft^2	Line 10
Area Associated With 18 Inch Depth		ft^2	Line 11
Area Associated With 3 Foot Depth		ft^2	Line 12
Total Allotted Width For Pocket Wetlands		ft	Line 13
Total Width of 6 Inch Depth		ft	Line 14
Total Width of 18 Inch Depth		ft	Line 15
Total Width of 3 Foot Depth		ft	Line 16
Length Required For Each Depth			
Length Associated With 6 Inch Depth		ft	Line 17
Length Associated With 18 Inch Depth		ft	Line 18
Length Associated With 3 Foot Depth		ft	Line 19
Recovery Time 6 Inch Depth		hr	Line 20
18 Inch Depth		hr	Line 21
The 3 Foot Depth Should Always Have Water			Line 22

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