3.0 Required Water Storage Calculations

Nitrogen and phosphorus are some of the major water quality pollutants that originate from rural and urban areas. When these pollutants enter natural waterways, they can lead to excess algae growth and depletion of dissolved oxygen. As a community, we can reduce the amount of nutrients leaving our properties by collecting it and reusing it or allowing it to be naturally filtered by plants and soil. Common pollutants and contributing sources are provided in the table below. [4]

Table 4. Common Pollutants and Their Sources

Pollutant	Contributing Source
Nitrogen and Phosphorus	Lawn fertilizers, soil erosion, animal waste, detergents, vehicle exhaust.
Sediment and Debris	Lawns, driveways, roads, drainage channel erosion, construction activities.
Pesticides and Herbicides	Residential lawns, gardens, commercial landscaped areas.
Organic Material	Residential lawns, gardens, commercial landscaped areas, animal waste.
Oil and Grease / Hydrocarbons	Roads, driveways, parking lots, gas stations.
Bacteria and Viruses	Septic systems, animal waste, sewer cross-connections, lift stations.
Metals	Vehicles, industrial areas, soil erosion, corroding surfaces.

https://www.epa.gov/sites/production/files/2015-10/documents/usw_b.pdf

3.1 Water Quality - Treatment Volume Calculation

LDC Chapter 5.06.00 *Stormwater Management* provides guidance associated with the minimum volume of stormwater to be retained on-site. According to the LDC, **large development projects** are required to collect and treat different volumes of water based on if the system is allowed to dry out in between storms or if it will always retain water.

It is the intent of the County to simplify the stormwater management criteria for small single-family residential lots. Improvement to small single-family residential lots don't exasperate stormwater issues individually, however if you consider the cumulative effects of multiple lots than stormwater issues become a compounding problem. This is why it is important for each residence to manage a small portion of stormwater on-site through LID SWMF. Single-family homes may not create a large difference individually, but as a whole the effects can be substantial.

[4] Environmental Protection Agency. Urban Stormwater Preliminary Data Summary. 2015. https://www.epa.gov/sites/production/files/2015-10/documents/usw_b.pdf

The criteria for stormwater quality management associated with single-family residential lots established with this manual is as follows:

a) if the LID SWMF completely dries out between storms - on-site storage and treatment of one-half inch of rainfall over the total disturbed area or runoff from one-inch over the total proposed impervious area associated with the parcel, whichever is greater;
b) if the LID SWMF is designed to retain water between storms - on-site storage and treatment of one-inch of rainfall over the total proposed impervious area associated with the parcel;

SWMF examples of impervious area include any type of pavement or structure that does not allow water to move through it and into the underlying soils. The following calculations provide an example on how to determine the criteria for your project.

1. First calculate the volume to treat one half-inch of rainfall over the total project area by using the following equation:

Retention criteria = ½-inch rainfall x Total Project Area (ft²)				
0.5 in x	***1 ft / 12 in***	***x Total Project Area (ft²)***	***=***	***Required 0.5-in Storage Volume (ft³)***

2. Now calculate the volume to treat one-inch of rainfall over the total impervious area by using the following equation:

Retention criteria = 1-inch rainfall x Total Impervious Area (ft²)				
1 in x	***1 ft / 12 in***	***x Total Imp. Area (ft²)***	***=***	***Required 1-in Storage Volume (ft³)***

3. The required stormwater treatment capacity will be the larger of the two values from above.

4. Example: If your lot is 0.25 acres and you have a 2,000 ft^2 (footprint) house and a 500 ft^2 driveway the required 1/2-inch storage volume will be as follows:

First, convert acres to square feet:

Acres	*******	***43,560 (ft²) / 1 acre***	***=***	***Square Feet***
0.25 acres		*43,560 ft² / 1 acre*		*10,890 ft²*

The required 1/2-inch storage volume will be as follows:

$$0.5 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} \times 10{,}890 \text{ ft}^2 = 453.75 \text{ ft}^3$$

Larger Value

The required 1-inch storage volume will be as follows:

$$1 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} \times (2{,}000 \text{ ft}^2 + 500 \text{ ft}^2) = 208.33 \text{ ft}^3$$

The storage volume associated with water treatment is 453.75 ft^3.

Refer to the Site Characteristics Calculation Sheet on page 26 for assistance in determining the required treatment volume for your property.

important If you are interested in reducing the stormwater storage requirements for your lot consider installing pervious pavement for patios, sidewalks, and driveways instead of traditional concrete. Refer to **Section 5.8** for more information on how the installation of pervious pavement can result in less stormwater storage requirements, as well as, example calculations.

If you have any questions regarding how to calculate the stormwater requirements for your project, please contact the Walton County Planning Department for assistance.

Water Quantity – Flood Attenuation Calculation

A water budget is the application of conservation and takes into account the total quantity of water entering an area minus water leaving an area. For simplicity, we will only consider water leaving a SWMF through infiltration.

Attenuation is the reduction of post-development peak flow or runoff, back to pre-development peak flow (runoff). This is accomplished by storing the excess stormwater during a storm and slowly releasing it through infiltration over a longer duration than would normally occur after a site has been developed. The lowered rate of release re-establishes the natural hydrology of the parcel and connected hydraulic systems in the surrounding area.

The criteria for stormwater quantity management (attenuation) associated with single-family residential lots established with this manual is as follows:

a) The LID SWMF requires to provide water quantity management to a portion of the rainfall generated from a 5-year 24-hour storm event (unless your parcel is in ICPAL) over the total impervious area associated with the parcel. In Walton County this storm event is equivalent to 7.13-inches of rainfall and its intensity is 0.30 in/hr. (The anticipated rainfall for additional design storms is provided in **Appendix C**)

Design Storm	Rainfall Depth	Rainfall Intensity
5-year 24-hour	**7.13-inches**	**0.30 in/hr**
ICPAL; 100-year 24-hour	**14.70-inches**	**0.61 in/hr**

b) The portion of the rainfall required to be stored will depend on the soil type at the location of your LID SWMF and your proposed ISR. Refer to **Section 2.0** on how to determine the size of your property and the total impervious area. From this information, you will calculate the proposed ISR.

Example: your property is 0.25 acres (AC) and your proposed impervious area is 2,500 ft^2.

$$0.25\ AC \times \frac{43{,}560\ ft^2}{1\ AC} = 10{,}890\ ft^2$$

$$\frac{\text{Proposed Impervious Area } (ft^2)}{\text{Total Site Area } (ft^2)} = \text{Impervious Surface Ratio (ISR)}$$

$$\frac{2{,}500\ ft^2}{10{,}890\ ft^2} = 0.22 \text{ (or 22\%)}$$

c) From **Section 2.4**, **Table 3** obtain the permeability rate associated with the soil at the location of your proposed LID SWMF. Remember, we will apply a safety factor (SF) of 2 (divide the permeability rate by 2) to the permeability rate as required by standard practice. For example, if your site has soil identified as Foxworth (HSG A) than according to the information provided in **Table 3** the permeability rate will be 20 in/hr. After applying the SF equal to 2, the design permeability rate will be 10 in/hr.

d) The portion of the rainfall depth required to be stored is calculated by using the following equation:

Rainfall Intensity (in/hr) / ***Design Permeability Rate (in/hr)***	***x***	***Rainfall Depth (in)***	***=***	***Reduced Rainfall Depth (in)***
0.30 in/hr / *10 in/hr*	*x*	*7.13 in*	*=*	*0.21 in*

e) The design rainfall depth is based on your proposed ISR.

Proposed ISR	Design Factor
Less than 40% (<0.4)	1.0
40% - 70% (0.4-0.7)	1.2
Greater than 70% (>0.7)	1.4

Reduced Rainfall Depth (in)	***x***	***Design Factor***	***=***	***Design Rainfall Depth (in)***
0.21 in	*x*	*1.2 =*		*0.25 in*

f) The design rainfall depth multiplied with the total impervious area of your site equals the required storage volume associated with flood attenuation.

Design Rainfall Depth (in)	***x***	***1 ft*** / ***12 in***	***x***	***Total Impervious Area (ft^2)***	***=***	***Required Storage Volume (ft^3)***
0.25 in	*x*	*1 ft* / *12 in*	*x*	*2,500 ft^2*	*=*	*52 ft^3*

The storage volume associated with flood attenuation is 52 ft^3.

a) If the soil at the site has a permeability rate of 0.6 in/hr the flood attenuation would be as follows:

Rainfall Intensity (in/hr) / ***Design Permeability Rate (in/hr)***	***x***	***Rainfall Depth (in)***	***=***	***Reduced Rainfall Depth (in)***
0.30 in/hr / *0.5*0.6 in/hr*	*x*	*7.13 in*	*=*	*7.13 in*

b) The design rainfall depth is based on your proposed ISR.

Proposed ISR	Design Factor
Less than 40% (<0.4)	1.0
40% - 70% (0.4-0.7)	1.2
Greater than 70% (>0.7)	1.4

Reduced Rainfall Depth (in)	***x***	***Design Factor***	***=***	***Design Rainfall Depth (in)***
7.13 in	*x*	*1.2 =*		*8.55 in*

c) The design rainfall depth multiplied with the total impervious area of your site equals the required storage volume associated with flood attenuation.

Design Rainfall Depth (in)	***x***	$\frac{1\ ft}{12\ in}$	***x***	***Total Impervious Area (ft^2)***	***=***	***Required Storage Volume (ft^3)***
8.55 in	*x*	$\frac{1\ ft}{12\ in}$	*x*	*2,500 ft^2*	*=*	*1,781 ft^3*

3.2 Required Storage Volume

In Section 3.2 and 3.3 we calculated different volumes based on different requirements. You will need to design your LID SWMF to be able to hold the largest of these three volumes. In our case, we have the following:

The storage volume associated with water treatment is 453.75 ft^3.

The storage volume associated with flood attenuation is 52 ft^3.

Therefore the required storage volume is 453.75 ft^3 ~ 454 ft^3 (remember to always round up)

If the storage volume associated with flood attenuation (**Section 3.2**) is significantly larger than the storage volume associated with water treatment (**Section 3.1**) it is likely, because you have poor soil conditions. In this case, it might be beneficial to consult with a licensed civil engineer regarding the design of a smaller, but more complex optimized system.

3.3 ICPAL Volume Calculation

Due to the increased flooding potential for properties located in an ICPAL, the stormwater attenuation volume must be increased to the 100-year 24-hour storm. The methodology used to determine the required treatment and attenuation volume for the SWMF are the same calculations presented in **Section 3.1 and 3.2**; the only difference is that you will substitute the rainfall amount used in the attenuation calculations from 7.13 inches to 14.7 inches and the rainfall intensity will be adjusted to 0.61 in/hr (See **Appendix C**).

The calculations are as follows:

a) The portion of the rainfall depth required to be stored is calculated by using the following equation:

$$\frac{\textbf{Rainfall Intensity (in/hr)}}{\textbf{Design Permeability Rate (in/hr)}} \times \textbf{Rainfall Depth (in)} = \textbf{Reduced Rainfall Depth (in)}$$

$$\frac{0.60 \text{ in/hr}}{10 \text{ in/hr}} \times 14.7 \text{ in} = 0.88 \text{ in}$$

b) The design rainfall depth is based on your proposed ISR.

Proposed ISR	Design Factor
Less than 40% (<0.4)	1.0
40% - 70% (0.4-0.7)	1.2
Greater than 70% (>0.7)	1.4

Reduced Rainfall Depth (in)	*x*	*Design Factor*	*=*	*Design Rainfall Depth (in)*
0.88 in	*x*	*1.2 =*		*1.05 in*

c) The design rainfall depth multiplied with the total impervious area of your site equals the required storage volume associated with flood attenuation.

Design Rainfall Depth (in)	*x*	$\frac{1\ ft}{12\ in}$	*x*	*Total Impervious Area* (ft^2)	*=*	*Required Storage Volume* (ft^3)
1.05 in	*x*	$\frac{1\ ft}{12\ in}$	*x*	*2,500* ft^2	*=*	*220.5* ft^3

The storage volume associated with flood attenuation is 221 ft^3.

a) If the soil at the site has a permeability rate of 0.6 in/hr the flood attenuation would be as follows:

$\frac{\text{Rainfall Intensity (in/hr)}}{\text{Design Permeability Rate (in/hr)}}$	*x*	*Rainfall Depth (in)*	*=*	*Reduced Rainfall Depth (in)*
$\frac{0.60\ in/hr}{0.5*0.6\ in/hr}$	*x*	*14.7 in*	*=*	*29.4 in*

b) The design rainfall depth is based on your proposed ISR.

Proposed ISR	Design Factor
Less than 40% (<0.4)	1.0
40% - 70% (0.4-0.7)	1.2
Greater than 70% (>0.7)	1.4

Reduced Rainfall Depth (in)	*x*	*Design Factor*	*=*	*Design Rainfall Depth (in)*
29.4 in	*x*	*1.2 =*		*35.2 in*

c) The design rainfall depth multiplied with the total impervious area of your site equals to the required storage volume associated with flood attenuation.

Design Rainfall Depth (in)	***x***	$\frac{\textbf{1 ft}}{\textbf{12 in}}$	***x***	***Total Impervious Area*** (ft^2)	**=**	***Required Storage Volume*** (ft^3)
35.2 in	*x*	$\frac{1\ ft}{12\ in}$	*x*	*2,500* ft^2	=	*7,350* ft^3

In this case it is highly recommended that the home owner contact an engineer for further assistance with the design of the SWMF.

3.4 Dune Lake Volume Calculation

Dune lakes are a valuable environmental asset for water quality and they must be protected. Areas within a dune lake buffer zone and dune lake tributary shall increase the stormwater retention volume by 150%. The methodology used to determine the required treatment and attenuation volume for the SWMF are the same calculations presented in in **Section 3.1 and 3.2.**; the only difference is that once you have determined the highest volume you will multiply the number by 1.5.

3.5 Mosquito Control Ditch Volume Calculation

If your property will release water into a Walton County mosquito control ditch the stormwater attenuation volume must be increased to the 24-hour 100-year storm, similar to areas in an ICPAL. The methodology used to determine the required treatment and attenuation volume for the SWMF are the same calculations presented in in **Section 3.1 and 3.2**. The only difference is that you will substitute the rainfall amount used in the attenuation calculations from 8 inches to 14.7 inches and the rainfall intensity will be adjusted to 0.61 in/hr (See **Appendix C**).

Attenuation Calculation Sheet

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	0.33	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	7.13	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