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Stormwater Mitigation

In compliance with the National Pollution Discharge Elimination System permit # TNS076121, the University of Tennessee Knoxville has developed an offsite mitigation program and payment in lieu of Stormwater fund that has the ability to offset all or a portion of the required Stormwater Management Volume that cannot be managed on site. Projects that disturb greater than or equal to 1 acre will be eligible to participate in this program. The purpose of this program is to allow options for Capital projects that are unable to meet their requirements within the project limits of construction.

Section A – Capital Projects

Capital Project Requirements –The project must satisfy the following requirements before it is able to take advantage of the Stormwater Mitigation Program.

- a. UT Stormwater will consider alternatives for sites that have proven to be technically infeasible to achieve the stay-on volume performance standard.
- b. Economic hardship imposed solely by the design is not presumed to be a basis for site infeasibility.
- c. All projects seeking to participate in the Stormwater Mitigation Program must first be approved by the UT Stormwater Executive Committee.
- d. Water quality criteria of the stormwater discharge must be addressed by the primary project regardless of participation in the Stormwater Mitigation Program. 80% of suspended solids must be removed prior to discharge of any stormwater.
- e. If participating in the Stormwater Mitigation Program the project will be unable to take advantage of any of the stormwater reduction incentives outlined in the UT Runoff Reduction Policy.
- f. Projects must satisfy all requirements of the UT NPDES permit.
- g. If a capital project exceeds the onsite requirements, then the surplus volume will be added to the banked volume for use by another project.

Section B – Mitigation Projects

Mitigation Project Requirements – Off-site mitigation may be performed or installed on campus to offset a capital project's inability to address the onsite Stormwater management volume. Approved applicants may elect to participate in offsite mitigation that satisfies the following criteria.

- a. Offsite mitigation may be performed or installed on redevelopment and/or retrofit sites.
- b. These sites will potentially have their own Stormwater management volume requirements in addition to accommodating any offsite mitigation volumes. Each project must satisfy its own requirements prior to offsetting the requirements of other capital projects.
- c. Required management volumes will be calculated based on the projects' cumulative square footage of impervious surface.

- d. To incentivize a project to manage its Stormwater on the project site, the volume generated by a 1 inch rain event at the primary project will be multiplied by 1.5 for sizing the required mitigation.
- e. Offsite mitigation is permitted only within the UT campus properties which fall within the same USGS 12 digit hydrologic unit code (HUC) as the primary project.
- f. Offsite mitigation must be completed within three (3) years of project approval.
- g. Sites designated as mitigation sites must be protected from disturbance. If a mitigation project site is disturbed it must be replaced at 2 times the current volume of mitigation.
- h. If a mitigation project has additional gallons not allocated to a current capital project then the remaining volume may be sold to an existing project at market rate.
- i. Offsite mitigation projects may be constructed in the form of
 - i. Capture, treat, or reuse
 - ii. Shoreline stabilization
- b. The extent of shoreline stabilization projects will be determined through the use of a “green roof equivalent,” described in detail in Section E of this document.

Section C – Stormwater Mitigation Fund

In-Lieu-of Fees – A capital project may pay into the Stormwater mitigation fund via in lieu of fees.

- a. The established currency for the Stormwater mitigation fund is gallons.
- b. Gallons will be sold at a rate consistent with the open market that is benchmarked by other Municipal Separate Storm Sewer Systems (MS4’s) in Tennessee. The rate will be assessed upon initiation of the project.
- c. Partial participation is an option, however a minimum of 10,000 gallons must be purchased by a capital project in order to participate in the Stormwater Mitigation Program. If a project is only able to manage a portion of the required volume, the remaining volume of Stormwater will be multiplied by 1.5.
- d. The Stormwater monies collected will be used to fund separate projects used for mitigation purposes, and not to satisfy other capital project requirements. The University of Tennessee Knoxville will be responsible for creating projects designated as Stormwater mitigation to use the collected funds.
- e. All credits subject to changes in Federal or State Law and/or regulation or changes to the UT NPDES permit that may increase or decrease restrictions on Stormwater discharges.

Section D – Tracking Resources

Tracking – Detailed tracking of credits and monies paid into the Stormwater mitigation fund is essential in maintaining permit compliance.

- a. The Vice Chancellor of Finance and Administration will be responsible for tracking dollars moved from capital project funds and placed into the Stormwater Mitigation Program fund.
- b. A GIS based system will keep track of mitigation projects, available gallons remaining (if any), and the project or projects that have used the mitigation sites to offset their onsite requirements.

Section E – Mitigation Project Design Procedure

Capture, Treat, or Reuse Method – Stormwater can be managed offsite through the traditional use of green infrastructure and best management practices for stormwater management. Gallons to be managed through an offsite stormwater mitigation project can be calculated through the process described in figure 1.

	STEP 1	2	3	4	5
NOTES/DESCRIPTION	Project can not meet Storm Water Permit Requirement on-site.	Calculate On-Site SW Management Volume	Apply Incentive Factor to the On-Site SW Management Volume to determine the Off-set SW Management Volume .	The project must satisfy an Offset SW Management Volume through the Mitigation Bank by contributing to the In-Lieu-of Fund .	The In-Lieu-of Fund will be used to construct storm water management projects that benefit the Campus.
	The project must address water quality with installation of a water quality unit on-site, as a minimum.	The impervious square footage is multiplied by 1" rainfall. SW Management Volumes are computed in Gallons.	The On-Site SW Management Volume is multiplied by 1.5. Projects are incentivized to manage storm water on-site.	An open market price per gallon (currently \$10.50/gallon) will be applied to the Offset SW Management Volume .	The Offset SW Management Volume will be deducted from the Mitigation Bank's available total volume.
CALCULATIONS	Area measured from project plans. SQ. FT.	SQ. FT. X 0.08333 = Cubic Feet Cu. Ft. x 7.48 = Gal.	On-site Gal x 1.5 = Off-set Gal.	Off-set Gal. X \$10.50 = "in-lieu-of" contribution	
UNITS	Impervious Surface (SQ. FT.)	On-Site (GALLONS)	Offset (GALLONS)	Fund Contribution (DOLLARS)	
EXAMPLE PROJECT	50,000.00	31,166.54	46,749.81	\$490,873.04	

Figure 1. Process used to calculate the amount of gallons to be managed through an offsite stormwater mitigation project, and how much will be contributed to the In-Lieu-of Fund.

Shoreline Stabilization Design Procedure – Shoreline stabilization will be used as a form of stormwater mitigation. A quantity of gallons that need to be treated offsite will correspond to an area of shoreline to be stabilized. This will be done through the use of a standardized “green roof equivalent” design, which will equate gallons of storage to square footage of stabilization.

- a. Shoreline conditions will be assessed using the UT Stream/River Shoreline Erosion Investigation Criteria (table 1). Shoreline that is classified as needing stabilization will be eligible to be stabilized as a form of stormwater mitigation.

Table 1. UT Stream/River Shoreline Erosion Investigation Criteria (TVA, 1998; USDA, 2016)

Soil Erosion	Bank Height (ft)	Slope	Vegetative Cover
None	--	--	Paved road/ramp, parking lot, rock outcrop, bluff
No Stabilization Needed	< 1	< 45°	Adequate vegetative cover
Stabilization Needed	< 1	< 45°	Limited to no vegetative cover
Intensive Stabilization Needed	1 - 3	> 45°	Limited to no vegetative cover
Critical Stabilization Needed	3 - 6	> 45°	Limited to no vegetative cover
Extremely Critical Stabilization Needed	> 6	> 45°	Limited to no vegetative cover

- b. A standardized green roof design will be used to equate the necessary water treatment volume of generated stormwater from new development to the area of shoreline stabilization needed.
 - i. This green roof equivalency guideline was completed using stormwater retention analysis calculations from the Tennessee Permanent Stormwater Management and Design Guidance Manual. The following equation (eq. 1) was used to determine the water quality treatment storage volume retained by a green roof (TDEC, 2014):

$$V = (A * D * n) / 12 \tag{1}$$

where,

V = storage volume (ft³)

A = roof area (ft²)

D = media depth (in.)

n = media porosity.

These calculations yielded an approximate value of 4.3 gallons of rainfall retention per square foot of green roof, when using this specific green roof design standard (fig. 2) (Hydrotech, 2020).

Area of Green Roof (A)	Inches of Growing Media (D1)	Maximum media water capacity (n1)	Depth of Retention Layer Inches (D2)	Maximum retention layer water capacity (n2)	Total Cubic Feet of water storage	Inches per square foot	Gallons per SF
12" LiteTop Growing Media + 1" Needled Rock Wool							
1,079	x 12	x 0.49	+ 1	x 0.93	= 617	6.86	4.3
12							

Figure 2. Water storage volume calculations from the Zeanah Wing 3 green roof assembly on the University of Tennessee Knoxville campus (Hydrotech, 2020). This design will be used as the “green roof equivalent” standard for shoreline stabilization mitigation projects.

- c. The determined water quality treatment storage volume for the standardized green roof design was calculated to be **4.3 gal ft⁻²**. This water storage value will be applied to the gallons bought from the stormwater bank using equation 2 below. The amount of green roof area necessary to treat the generated stormwater volume is equivalent to the square footage of sheer bank area that will be stabilized. To treat the generated stormwater volume with a shoreline stabilization project, the area of bank to be stabilized will be

$$A * 1.5 = V / S \tag{2}$$

where,

A = Area of shoreline to be stabilized (ft²)

1.5 = Required 1.5 multiplier, per TDEC guidance

V = Gallons purchased from stormwater bank

S = Water quality treatment storage volume = 4.3 gal ft⁻².

For a project generating 31,166 gal of stormwater from 50,000 ft² of impervious surface (figure 1), equation 2 can be used to calculate the area of shoreline to be stabilized as shown below:

$$A * 1.5 = V / S$$

$$A * 1.5 = 46,749 \text{ gal} / 4.3 \text{ gal ft}^{-2}$$

$$A = 7,248.03 \text{ ft}^2.$$

References

Hydrotech. (2020). *Tennessee State Stormwater Retention Analysis - UT ESF - Wing 3*. Knoxville, Tennessee: Hydrotech USA.

Tennessee Department of Environment and Conservation (TDEC). (2014). *Tennessee Permanent Stormwater Management and Design Guidance Manual*.

Tennessee Valley Authority (TVA). (1998, November). *Shoreline Management Policy*. Retrieved from Tennessee Valley Authority: https://tva-azr-eastus-cdn-ep-tvawcm-prd.azureedge.net/cdn-tvawcma/docs/default-source/default-document-library/site-content/environment/shoreline-construction-26a/v1_toc.pdf?sfvrsn=94babef9_0

U.S. Department of Agriculture (USDA). (2016). *Bank Stability and Toe Erosion Model, v5.4, Model documentation*. Oxford, MS: USDA-ARS. Retrieved from Agricultural Research Service.