Statewide Best Management Practice (BMP) Efficiencies for Crediting Projects in Basin Management Action Plans (BMAPs) and Alternative Restoration Plans

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This document describes the DEP methods to calculate total nitrogen (TN) and total phosphorus (TP) reductions for watershed restoration, when site-specific information is not available. These calculation methods represent typical BMP performance in Florida, which may be useful to stakeholders when selecting BMPs to achieve nutrient load reductions related to the development and implementation of BMAPs, 4e plans, and 4b/reasonable assurance plans (RAPs). DEP assigns nutrient removal efficiencies and nutrient credits to BMPs on a case-by-case basis, using the information in this document as a guide during the decision-making process. This working document will be updated periodically as new information becomes available. To download the latest version, visit: http://publicfiles.dep.state.fl.us/DEAR/BMAP/Resources/.

These calculation methods are not designed for use with Environmental Resource Permits (ERPs). The appropriate permitting agency should be consulted for its approved calculation methods.

For quick reference, the following summary tables and figures are included:

- **Table 1** lists the removal efficiencies for various standard BMP types.
- **Table 2** lists the TN and TP reductions for provisional nonpoint source management BMPs.
- **Table 3** lists the BMPs for which data are lacking and water quality benefits are unknown. As additional data become available, these BMPs may be assigned provisional load reduction credits.
- Specific activities ineligible for nutrient credits include macroalgal harvesting and natural wetlands as filters, as listed in **Table 4**.
- Equations for online and offline retention BMPs are listed in **Table 5** and are based on the volume resulting from multiplying the corresponding inches of retention and the sub-basin area.
- In addition, this document includes wet detention removal efficiency curves for TP (**Figure 1**) and TN (**Figure 2**).

Macroalgal harvesting from an impaired waterbody is not eligible for credits, because it is a biological result of nutrient loading that should be abated before it reaches the waterbody of concern. See **Table 2** for information about aquatic vegetation harvesting that **is** eligible for

credit, based on specific conditions. Filtration from natural wetlands is ineligible for credit, because this is considered part of the existing conditions when required load reductions are determined. Various types of artificial wetlands and modular wetland treatment systems **are** eligible for nutrient credits.

It should be noted that for certain BMPs, reductions resulting from regular required maintenance are implicit in the initial credit given during installation or implementation. Therefore, operations and maintenance (O&M) required for the BMP will not qualify for additional credits. However, if a project did not receive credits for the initial installation or implementation of the BMP, regular maintenance may qualify for credit. Decisions will be made on a case-by-case basis.

All treatment trains—BMPs with more than one treatment type—should be calculated in series where the treated loading from the first BMP should be considered as the input loading for the next BMP. The procedure is important to apply the correct reduction for treatments in series with each other.

Table 1: Efficiencies for nonpoint source management BMPs

N/A = Not applicable
All BMPs must be designed to manufacturers' recommendations and 80 % removal of total suspended solids (TSS).
[1] Includes retention basins, exfiltration trenches, impoundments, control structures, etc
[2] Includes hydrologic restoration projects that increase detention.
[3] The benefits of a baffle box—including BMP maintenance—are included in the baffle box credits when they are installed.

BMP Type	Standard BMPs	TP % Reduction	TN % Reduction	Data Source
Retention[1]	**Offline retention BMPs (must limit catchment to <10 acres)**	See **Table 5** for formulas	See **Table 5** for formulas	*Evaluation of current stormwater design criteria within the state of Florida*, Harper, H., and D. Baker 2007; and DEP evaluation/ regression of Harper and Baker 2007
	Online retention BMPs	See **Table 5** for formulas	See **Table 5** for formulas	DEP evaluation/regression of Harper and Baker 2007
	Grass swales with swale blocks or raised culverts	Use on-line retention BMPs	Use online retention BMPs	DEP evaluation/regression of Harper and Baker 2007
	Grass swales without swale blocks or raised culverts	50 % of value for grass swales with swale blocks or raised culverts	50 % of value for grass swales with swale blocks or raised culverts	DEP evaluation/regression of Harper and Baker 2007
	Retention or Detention BMPs with Nutrient Reducing Media	Use appropriate retention/detention calculation and add media % removal as a treatment train (see **Table 2** for media mix efficiencies from the 2020 or newer BMPTRAINS User's Manual and unlisted media mixes)	Use appropriate retention/detention calculation and add media % removal as a treatment train (see **Table 2** for media mix efficiencies from the 2020 or newer BMPTRAINS User's Manual and unlisted media mixes)	2020 or newer BMPTRAINS User's Manual
Detention[2]	**Wet detention ponds**	Formula shown in Figure 13.2 of *Draft stormwater treatment applicant's handbook* (see **Figure 1** below for formula)	Formula shown in Figure 13.3 of *Draft stormwater treatment applicant's handbook* (see **Figure 2**Figure 2 below for formula)	March 2010 draft DEP and water management districts (WMDs) *ERP Stormwater Quality Applicant's Handbook*
	Dry detention ponds	10 %	10 %	DEP evaluation/regression of Harper and Baker 2007

BMP Type	Standard BMPs	TP % Reduction	TN % Reduction	Data Source
Baffle Boxes	**Baffle boxes (gravity-based separators)—First generation[3]**	2.30 %	0.50 %	Final report, Contract S0236, *Effectiveness of baffle boxes plus media filter*, by GPI Southeast 2010; *Demonstration bio media for ultra-urban stormwater treatment*, by University of Central Florida (UCF) for Florida Department of Transportation (FDOT); and Final report, Contract S0497, *Baffle box with media filtration installation and effectiveness evaluation* by City of Casselberry, 2020 BMPTRAINS User's Manual (Wanielista, Harper, Livingston, Hardin, Kuzlo, and Gogo-Abite)
	Baffle boxes (gravity-based separators)—Second generation[3]	15.5 %	19.05 %	
	Baffle boxes (gravity-based separators)—Second generation plus media filter[2]	Media Mix Efficiency (see **Table 2** for media mix efficiencies from the 2020 or newer BMPTRAINS User's Manual and unlisted media mixes) followed by second generation baffle box efficiency above	Media Mix Efficiency (see **Table 2** for media mix efficiencies from the 2020 or newer BMPTRAINS User's Manual and unlisted media mixes) followed by second generation baffle box efficiency above	
Hydrodynamic Separators	**Hydrodynamic separators (including vortex and continuous deflector separators [CDS] units)**	10 %	N/A	Final Report, Contract S0095, Sanford Stormceptor Project, 2008; Final Report, Contract WM793, Broadway Outfall Project, 2006

BMP Type	Standard BMPs	TP % Reduction	TN % Reduction	Data Source
Material Collection	**Street sweeping (materials collected from roadway and gutter sweeping)** **Do not include baffle box material collected[1]—see baffle box category above that includes maintenance benefits**	Determine annual average dry weight/volume of material collected over a period of 3 years (or representative period of current effort) and enter values into the Florida Stormwater Association (FSA) University of Florida (UF) Municipal Separate Storm Sewer (MS4) BMP Toolkit (FINAL MS4 Load Reduction Tool 2019 or newer version) for estimated TP reduction	Determine annual average dry weight/volume of material collected over a period of 3 years (or representative period of current effort) and enter values into the Florida Stormwater Association (FSA) University of Florida (UF) Municipal Separate Storm Sewer (MS4) BMP toolkit (FINAL MS4 Load Reduction Tool 2019 or newer version) for estimated TN reduction	2019 Final Report (or newer version), FSA UF MS4 BMP Project
	Catch basin inserts/inlet filter cleanout (drainage features and units with no specific water quality treatment mechanism), including the following: • Curb inlets. • Area catch basins. • Pavement catch basins. • Projects serving drainage and conveyance functions. • Swales (calculating under BMP cleanout category also acceptable). • Ditches (calculating under BMP cleanout category also acceptable). Do not include baffle box material collected[1]—see baffle box category above that includes maintenance benefits	Determine annual average dry weight/volume of material collected over a period of 3 years (or representative period of current effort) and enter values into the Florida Stormwater Association (FSA) University of Florida (UF) Municipal Separate Storm Sewer (MS4) BMP toolkit (FINAL MS4 Load Reduction Tool 2019 or newer version) for estimated TP reduction	Determine annual average dry weight/volume of material collected over a period of 3 years (or representative period of current effort) and enter values into the Florida Stormwater Association (FSA) University of Florida (UF) Municipal Separate Storm Sewer (MS4) BMP toolkit (FINAL MS4 Load Reduction Tool 2019 or newer version) for estimated TN reduction	2019 Final Report (or newer version), FSA UF MS4 BMP Project

BMP Type	Standard BMPs	TP % Reduction	TN % Reduction	Data Source
	BMP cleanout (volumetric stormwater features designed to catch solids and particles), including the following: • Basins. • Tanks. • Vaults. Note: Cleanout of wet and dry ponds is a required maintenance activity, included in the TP and TN reductions when the features are created. No additional credit for pond cleanouts. • Swales (calculating under catch basin cleanout category also acceptable). • Ditches (calculating under catch basin cleanout category also acceptable). **Do not include baffle box material collected[1]—see baffle box category above that includes maintenance benefits.**	Determine annual average dry weight/volume of material collected over a period of 3 years and enter values into the Florida Stormwater Association (FSA) University of Florida (UF) Municipal Separate Storm Sewer (MS4) BMP toolkit (FINAL MS4 Load Reduction Tool 2019 or newer version)	Determine annual average dry weight/volume of material collected over a period of 3 years and enter values into the Florida Stormwater Association (FSA) University of Florida (UF) Municipal Separate Storm Sewer (MS4) BMP toolkit (FINAL MS4 Load Reduction Tool 2019 or newer version)	2019 Final Report (or newer version) of FSA UF MS4 BMP Project
Green Infrastructure Efforts	**Green roofs (with or without cistern)**	BMPTRAINS model 2020 or newer	BMPTRAINS model 2020 or newer	UCF Stormwater Management Academy BMPTRAINS 2020 or newer model
	Rain gardens and bioswales	BMPTRAINS model 2020 or newer	BMPTRAINS model 2020 or newer	UCF Stormwater Management Academy BMPTRAINS 2020 or newer model
	Tree boxes/tree wells	BMPTRAINS model 2020 or newer	BMPTRAINS model 2020 or newer	UCF Stormwater Management Academy

BMP Type	Standard BMPs	TP % Reduction	TN % Reduction	Data Source
				BMPTRAINS 2020 or newer model
	Vegetated natural buffers/ vegetated filter strip	BMPTRAINS model 2020 or newer	BMPTRAINS model 2020 or newer	UCF Stormwater Management Academy BMPTRAINS 2020 or newer model
	Pervious pavement systems	BMPTRAINS model 2020 or newer	BMPTRAINS model 2020 or newer	UCF Stormwater Management Academy BMPTRAINS 2020 or newer model
Other BMP Types	**Stormwater alum injection systems**	90 %	50 %	Harper, H., and J. Herr 1998 study for DEP – *Alum treatment of stormwater: The first ten years*
	Floating islands/managed aquatic plant systems (MAPS)	10 % removal with 5 % pond coverage	10 % removal with 5 % pond coverage	UCF studies (two different studies with two different manufacturers)
	Stormwater reuse	Estimate annual load of stormwater (and percentage of total if not 100 %) not discharged because used for irrigation	Estimate annual load of stormwater (and percentage of total if not 100 %) not discharged because used for irrigation	Evaluated on case-by-case basis. Use of measured pump and nutrient concentration data are preferred.
	Constructed wetland treatment	Reduction is specific to site design and confirmed by monitoring	Reduction is specific to site design and confirmed by monitoring	Based on data and past performance for similar projects.
	Stormwater – injection well	Case-by-case basis	Case-by-case basis	Calculations are based on the loading permanently removed from the impaired water(s)

BMP Type	Standard BMPs	TP % Reduction	TN % Reduction	Data Source
	BMP treatment trains using a combination of BMPs	BMP Treatment Train equation: Efficiency = Eff1 +((1-Eff1) *Eff2) or BMPTRAINS model 2020 or newer	BMP Treatment Train equation: Efficiency = Eff1 +((1-Eff1) *Eff2) or BMPTRAINS model 2020 or newer	March 2010 draft DEP and WMDs *ERP Stormwater Quality Applicant's Handbook* and 2020 or newer UCF Stormwater Management Academy BMPTRAINS model
	Reclaimed water	Surface waters: Estimate annual load of water (and percentage of total if not 100%) not discharged because it was reclaimed. Springs: See springs methods for loads to groundwater.	Surface waters: Estimate annual load of water (and percentage of total if not 100%) not discharged because it was reclaimed. Springs: See springs methods for loads to groundwater.	Calculations are based on discharge monitoring reports (DMR) data and are credited based on the difference between the loading previously discharged to the surface water that is now reclaimed (where loading = concentration * volume * conversion factors).
	WWTF upgrade or WWTF nutrient reduction	Estimate difference in annual load to surface or groundwater pre- and post-upgrade. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Estimate difference in annual load to surface or groundwater pre- and post-upgrade. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Calculations are based on discharge monitoring reports (DMR) data and are credited based on the difference between the pre- and post-upgrade loading (where loading = concentration * volume * conversion factors).

BMP Type	Standard BMPs	TP % Reduction	TN % Reduction	Data Source
	WWTF disposal site or WWTF diversion to reuse	Estimate difference in annual load to surface or groundwater pre- and post-upgrade. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Estimate difference in annual load to surface or groundwater pre- and post-upgrade. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively	Calculations are based on discharge monitoring reports (DMR) data. Surface water is credited based on the change in load not directly discharged. In some cases, attenuation factors are applied; check with coordinator. Springsheds are credited based on the difference between groundwater loading of the previous versus current disposal methodologies.
	Wastewater – Injection Well	Case-by-case basis. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Case-by-case basis. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Calculations are based on discharge monitoring reports (DMR) data. Surface water is credited based on the change in load not directly discharged. In some cases, attenuation factors are applied; check with coordinator. Springsheds are credited based on the difference between groundwater loading of the previous versus current disposal methodologies.

BMP Type	Standard BMPs	TP % Reduction	TN % Reduction	Data Source
	Sanitary Sewer – Alum Injection System	Case-by-case basis. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Case-by-case basis. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Calculations are based on discharge monitoring reports (DMR) data. Surface water is credited based on the change in load not directly discharged. In some cases, attenuation factors are applied; check with coordinator. Springsheds are credited based on the difference between groundwater loading of the previous versus current disposal methodologies.
	Decommission/Abandonment	Estimate difference in annual load to surface or groundwater pre- and post-abandonment between the abandoned facility and the new facility water. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Estimate difference in annual load to surface or groundwater pre- and post-abandonment between the abandoned facility and the new facility water. Two to three years of data in each pre/post period are preferred, with a minimum of 12 months of pre and post data, respectively.	Calculations are based on discharge monitoring reports (DMR) data. Surface water is credited based on the change in load not directly discharged. In some cases, attenuation factors are applied; check with coordinator. Springsheds are credited based on the difference between groundwater loading of the previous versus current disposal methodologies.

Table 2: Efficiencies for provisional nonpoint source management BMPs

N/A = Not applicable

Provisional BMPs	TP % Reduction	TN % Reduction	Data Source
Public education efforts	0.25 % to 6 %, depending on extent of program and 4 specific ordinance types	0.25 % to 6 %, depending on extent of program and 4 specific ordinance types	Evaluation of Center for Watershed Protection. 2002. Watershed Treatment Model Version 3.1. Separate calculation spreadsheet available
Muck removal/ restoration dredging	Case-by-case depending on nutrient flux of muck	Case-by-case depending on nutrient flux of muck	DEP Muck Removal Credit Guidance October 2019 or newer (for use in Indian River Lagoon [IRL] BMAPs only). BMAPs outside IRL must provide locally relevant nutrient flux of muck information and other data similar to that presented in IRL Muck Removal Credit Guidance for DEP review.
Aquatic vegetation harvesting	Based on total mass of material collected, type of plant(s), and associated nutrient content in dry material	Based on total mass of material collected, type of plant(s), and associated nutrient content in dry material	DEP Removal of Aquatic Vegetation for Nutrient Credits (developed for IRL BMAPs)
OSTDS Phase Out (proper condemnation and hook-up to sewer service)	N/A	Surface waters and completed projects of >25 phase outs: ArcNLET model Surface water projects in planning phase or projects <25 phase outs: Other DEP-approved methods are available to estimate TN reduction Springsheds: Based on DEP OSTDS Springs Credit Estimator Toolkit (2020 version or newer)	Surface waters: ArcNLET model, TMDL Model, SJRWMD model Springsheds: OSTDS Springs Credit Estimator Toolkit All approaches can be found in the OSTDS_Calc Method for BMAPs Excel workbook
Dispersed water management (DWM)	Based on measured data or acre-feet (ac-ft) of storage and land use concentration	Based on measured data or ac-ft of storage and land use concentration	Determined through discussions between DEP and South Florida Water Management District (SFWMD)
Stormwater treatment areas (STAs)/Regional Stormwater Treatment (RST)	Based on engineering design calculations	Based on engineering design calculations	SFWMD

Provisional BMPs	TP % Reduction	TN % Reduction	Data Source
Denitrification walls	Case-by-case depending on quantitative data	Case-by-case depending on quantitative data	Determined on case-by-case basis
Biosorption activated media (BAM)	BMPTRAINS model 2020 or newer, if the BAM is listed. If the type of BAM is not provided in BMPTRAINS, pre/post project data and engineering designs and depth of media are needed to establish BAM efficiency.	BMPTRAINS model 2020 or newer, if the BAM is listed. If the type of BAM is not provided in BMPTRAINS, pre/post project data and engineering designs and depth of media are needed to establish BAM efficiency.	UCF Stormwater Management Academy BMPTRAINS 2020 or newer model or site-specific measured data and engineering designs and depth of media
Land use change	Dependent on difference between land use classification at BMAP adoption and updated land use classification	Dependent on difference between land use classification at BMAP adoption and updated land use classification	Determined on case-by-case basis
Fertilizer cessation or fertilizer reduction	Based on acreage previously fertilized, fertilization rates, and fertilizer composition	Based on acreage previously fertilized, fertilization rates, and fertilizer composition	Determined on case-by-case basis (see Orange Creek Basin BMAP for example)
Living shorelines/ Shoreline stabilization	Case-by-case depending on quantitative data	Case-by-case depending on quantitative data	See Patrick Air Force Base *Proposed Protocol for Shoreline Stabilization TMDL Project Credit – Revision 1*, April 25, 2019
Soil amendment ordinances	Case-by-case depending on quantitative data	Case-by-case depending on quantitative data	Adoption of model soil amendment ordinance or equivalent regulatory mechanism.
Golf course or sports field BMPs	Case-by-case depending on quantitative data and changes made to practices	Case-by-case depending on quantitative data and changes made to practices	Determined on case-by-case basis
Non-contributing basin or model-related adjustments	Case-by-case	Case-by-case	Determined on case-by-case basis

Table 3: BMPs for which data are lacking to assign credit/unknown benefits/no credit

BMPs Lacking Data for Credit
Creating/enhancing oyster reefs
Seagrass planting
Local code changes/regulations/ordinances/guidelines economic incentives (see public education efforts for specific credit policies)
Reduction of nutrients in reclaimed water
Enhanced public education
Plugging artesian wells
Retention of storm events larger than 4.0 inches
Turbidity-reducing polymers
Dragline restoration
Stormwater – biological/bacteria treatment (e.g., aerobic and anoxic bacteria for stormwater treatment, in waterbody sludge removal, etc.)

Table 4: Specific activities ineligible for nutrient credit

Ineligible BMPs/Activities
Macroalgal harvesting
Natural wetlands as filters
Exotic vegetation removal – note that credit may be given for aquatic vegetation harvesting
All fecal indicator bacteria (FIB) project types
Monitoring/data collection
Studies
Land acquisition/land preservation
Stormwater aeration systems
Wastewater service area expansion – credit can be given for OSTDS phase out based on the number of connections made
Inspection programs intended to ensure good working order, including sanitary sewer inspections
Maintenance activities include which maintain the permitted condition, including stormwater system rehabilitation, sanitary sewer and wastewater treatment facility (WWTF) maintenace

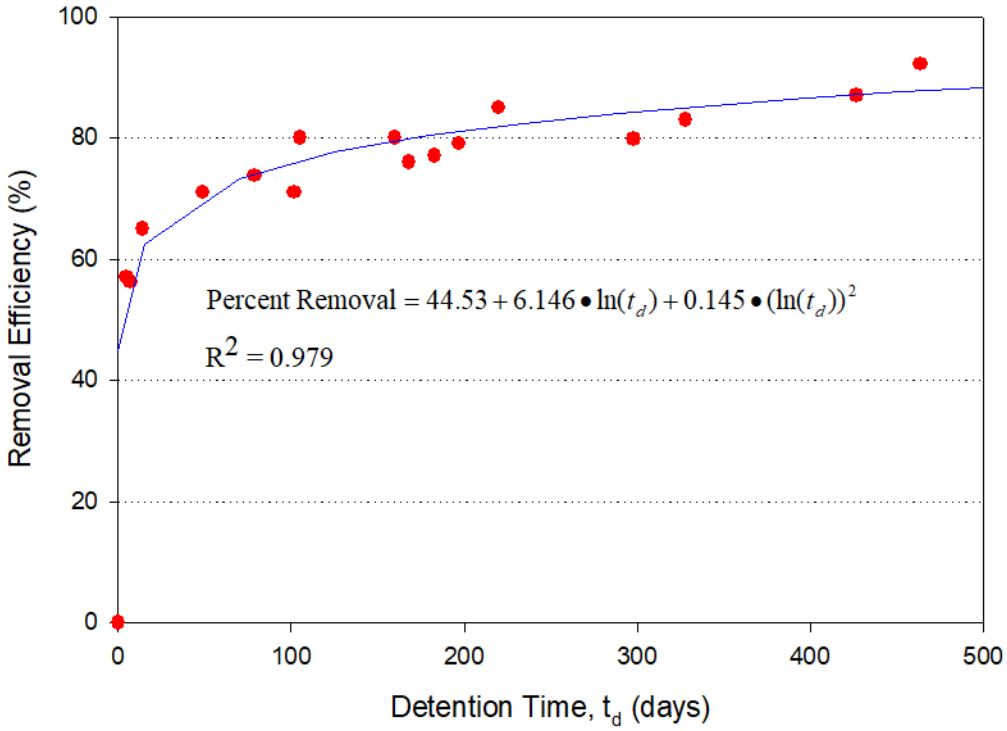

Figure 1: Wet detention removal efficiency curve for TP

Percent Removal = 44.53 + 6.146*ln(t_d) + 0.145*(ln(t_d))^2
where
T_d = (PPV/RO)*CF

where:
T_d = Detention time (days)
PPV = Permanent pool volume (ac-ft)
RO = Annual runoff inputs (ac-ft/year [yr])
CF = Conversion factor (365 days/yr)

and

RO =DA*C*R*CF

where:
RO = Annual runoff inputs (ac-ft/yr)
DA = Drainage area to pond (ac)
C = Mean annual runoff coefficient (BMPTRAINS 2020 or newer or Harper)
R = Mean annual rainfall (inches [in]/yr)
CF = Conversion factor (1 ft/12 in)

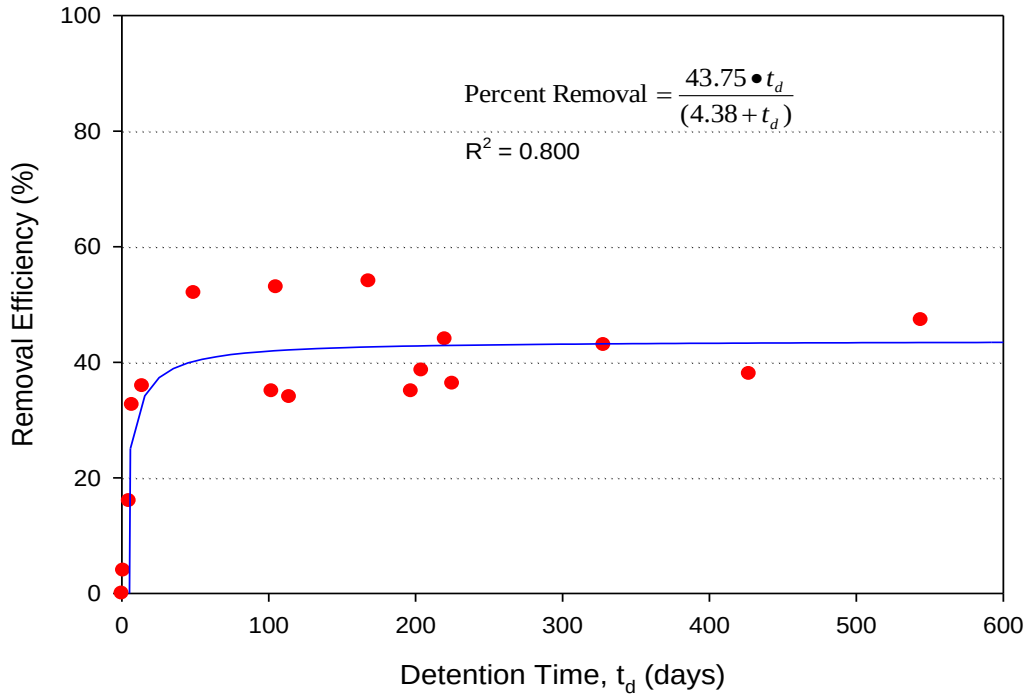

Figure 2: Wet detention removal efficiency curve for TN

T_d= (PPV/RO)*CF

where:
T_d = Detention time (days)
PPV = Permanent pool volume (ac-ft)
RO = Annual runoff inputs (ac-ft/yr)
CF = Conversion factor (365 days/yr)

and

RO =DA*C*R*CF

where:
RO = Annual runoff inputs (ac-ft/yr)
DA = Drainage area to pond (ac)
C = Mean Annual Runoff coefficient (BMPTRAINS 2020 or newer or Harper)
R = Mean annual rainfall (in/yr)
CF = Conversion factor (1 ft/12 in)

Table 5: Equations for online and offline retention BMPs

Standard BMPs	Inches of Retention	TP and TN % Reduction	Data Source
Retention BMPs (includes basins, exfiltration trenches, impoundments, etc.)	0.1 to 4.0	Based on percent reduction using project's percent directly connected impervious area (DCIA), non-DCIA curve number (CN), and rainfall zone	Appendix F, March 2010 Draft DEP and WMDs *ERP stormwater quality applicant's handbook* and *Evaluation of current stormwater design criteria within the state of Florida*, Harper and Baker 2007
Offline retention BMPs	0.1 to 1.6	0.3178 * ln(x) + 0.8405	DEP evaluation/regression of Harper and Baker 2007
Online retention BMPs	0.1 to 2.2	0.3178 * ln(x) + 0.7405	DEP evaluation/regression of Harper and Baker 2007