TREE CREDIT SYSTEMS AND INCENTIVES AT THE SITE SCALE

FINAL REPORT

Stone Project ID 12-161
February 28, 2014

Prepared for:
Urban and Community Forestry, Vermont Dept. of Forests, Parks & Rec.
Danielle Fitzko
1 National Life Drive, Davis 2
Montpelier, VT 05620-3801
Tel. / 802.598.9992
E-Mail / Danielle.fitzko@state.vt.us

Prepared by:
Stone Environmental, Inc.
Julie Moore, Amy Macrellis, Kate Bailey
535 Stone Cutters Way
Montpelier, VT 05602
Tel. / 802.229.1881
E-Mail / jmoore@stone-env.com

STONE ENVIRONMENTAL INC

ACKNOWLEDGEMENTS

This project was performed by Stone Environmental, Inc. for the Vermont Department of Forests, Parks, and Recreation with funding provided by the U.S. Forest Service Northeastern Area State and Private Forestry Competitive Allocation.

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

The preservation and planting of trees at the site scale is being more broadly encouraged through the use of "tree credits" and other incentives at the state and local government levels across the United States. A "credit", when considering a site-scale development or re-development project, is most commonly applied to the amount of stormwater that an applicant would otherwise be required to treat in exchange for—and to encourage—the use alternate practices that reduce the volume of runoff generated. For example, the Vermont Stormwater Management Manual provides stormwater credits for natural area conservation, disconnection of rooftop and non-rooftop runoff, stream buffers, grass channels, and environmentally sensitive rural development. The use of stormwater credits can result in cost savings to the applicant, by reducing the size of otherwise required structural stormwater practices.

Credit systems where calculations are specifically based on the stormwater management benefits of trees have proven very challenging to develop and implement (Shanstrom 2013):

> *Not only do tree benefits vary with tree size, they also vary with tree architecture, species, climate, season, proximity to impervious surface, storm intensity, frequency, duration, etc. Given that, does it make more sense to take a step back and base credits on the urban forest as a whole rather than per individual tree, and to set minimum size distribution and species standards for the forest as a whole? And how do we incentivize preserving large existing trees rather than just replacing them with small ones whenever possible? In all cases, who is responsible for the trees? … [I]s it possible to pull all these variables into a crediting system that is not too complicated to work, but still does not significantly over- or under- credit the stormwater benefits of trees?*

2. STATE-LEVEL CREDITS

Despite these challenges, a substantial number of states have established credit systems as part of their stormwater management programs that allow the site designer to subtract conservation areas or areas treated by a LID practice from the total site area or impervious area when computing the water quality volume and/or recharge volume (CWP and USFS-Northeastern Area, 2008). Table 1 presents several examples of how states have included credits for preserving trees at the site scale during development or redevelopment projects.

The range of tree-related practices eligible for credits in state-level programs or guidance manuals include natural area conservation, reforestation, and environmental site design. Other non-structural practices that do not necessarily include trees, such as impervious cover disconnection, sheetflow to buffers or filter strips, or open channels, are also included in the range of site-scale practices usually eligible for credits. In cases where site reforestation is included as a non-structural practice eligible for credit (as in Minnesota), the reforested area is not considered equivalent to forest conservation. For example, reforesting one acre of land may only receive 1/3 to ½ of the credit provided for conserving one acre of existing forest (CWP and USFS-Northeastern Area, 2008).

Table 1. Examples of state-level stormwater credits for non-structural practices that include trees.

	Site Scale Tree Practices Eligible for Credit in Manuals					
State	**Natural Area Conservation**	**Stream Buffers**	**Protect Existing Trees**	**Site Reforestation**	**Environmentally Sensitive Rural Development**	**Credits Offered**
Vermont	X	X			X	REv, WQv (partial)
Maine	X					REv, WQv
Massachusetts					X	REv, WQv
Minnesota	X	X		X		WQv, CPv, Qp10 (partial) Option for local jurisdictions to implement
Pennsylvania		X	X			WQv, REv, CPv, Qp10 (up to 25% of required volume)
Georgia	X	X			X	WQv, CPv (partial), Qp25 (partial)

Over the last decade, a marked shift has occurred in the stormwater management community away from the sole use of structural BMPs and towards embracing LID approaches and practices, including non-structural practices that emphasize the preservation or planting of trees. This shift is illustrated vividly in state-level stormwater management manuals and policies. All of the state-level stormwater management manuals reviewed except Vermont's contain explicit references to and definitions for "Low Impact Development", "Better Site Design", or a substantially equivalent philosophy of development site design. The levels to which these concepts are carried forward from the states' BMP manuals into regulations, and the extent to which stormwater designers are required or encouraged to implement LID practices, varies widely between the states surveyed. Table 2 summarizes some key examples of state-level requirements for the use of LID practices at the site or project scale that emphasize the retention or planting of trees.

As part of an effort to implement Minimal Impact Design Standards (MIDS) based on low impact development (LID), Minnesota's Pollution Control Authority is now making a concerted effort to develop and implement a robust system of stormwater credits for trees (Shanstrom 2013). Current research and standards development is focused on five main areas: the preservation of existing trees, stormwater credits for reforestation, promoting the use of trees for streambank protection and buffers, promoting the use of trees for shading as a thermal mitigatory BMP, the bioretention BMPs that trees are incorporated into (tree pits and tree filter designs) (MPCA 2013).

In January 2014, the following draft information was incorporated into the Minnesota Stormwater Manual:

- Water quality benefits of trees
- Tree species list
- Design specifications for trees and soils
- Construction specifications
- Protection of existing trees on construction sites
- O & M guidelines
- Monitoring guidelines
- Street sweeping
- Fact sheet
- Case studies
- Credits for evapotranspiration, canopy interception, and pollutant removal

Table 2. Examples of state-level requirements for non-structural practices that include trees.

	Site Scale Tree Practices Required (or Standard) in Manuals				
State	**Protect Areas that Provide WQ Benefits**	**Protect Natural Drainages & Vegetation**	**Minimize Clearing & Grading**	**Retain & Plant Native Vegetation**	**Requirements for consideration/use**
New Jersey	X	X	X	X	Required to MEP
Rhode Island	X	X	X	X	Required to MEP
New York	X	X	X	X	Can be used alone or with other practices to meet RRv (and/or to reduce required volumes for WQv, CPv)
Massachusetts	X	X	X	X	Practices are specified in manual but not required
Pennsylvania	X	X	X	X	Must be considered first (see credits in Table 1 above)
Minnesota	X	X	X	X	Better Site Design included in manual as a standard best management practice
Maryland	X	X	X	X	Environmental Site Design required to MEP
Georgia	X	X	X	X	Better Site Design practices required under Minimum Standard 1 (see credits in Table 1 above)
Washington	X	X	X	X	Minimum Standard 5 requires application of these and other LID practices

Trees are also being incorporated into the MIDS calculator application as accepted treatment practices. The calculator will incorporate volume reductions based on storage and infiltration within tree boxes and tree trenches, as well as volume reductions for canopy interception and evapotranspiration (MPCA 2014). This material is expected to be finalized in the spring of 2014. The manual also offers impervious cover reductions and adjusted curve numbers for natural area conservation, stream and shoreline buffers, and site reforestation (Table 2).

3. MUNICIPAL CREDIT PROGRAMS AND SYSTEMS

Municipalities are also adopting—or considering adoption of—stormwater credit programs that encourage the addition of more trees into a development or redevelopment site. In contrast to the non-structural practices required or offered for credit in state-level manuals, municipal-level credits and incentives are often awarded on an individual tree basis for runoff reduced through rainfall interception, evapotranspiration, and infiltration. A summary of credits for individual trees is provided in Table 3.

The most commonly implemented credit is a reduction in directly connected impervious area that must otherwise be treated on the site (ex. 100-200 ft^2 for newly planted trees, or half the canopy area of existing trees). There is usually a limit on the percentage of impervious area (e.g., 25%) that new or existing trees can be credited with reducing. Under these municipal tree credit programs, trees are usually only eligible for credit against ground-level impervious surfaces, and even then only if the trees are very close to those impervious surfaces (within 10-25 feet). Seattle's credit system was developed based on a literature review, and in contrast to most similar credits, it provides a much lower impervious surface reduction credit per tree compared to other cities (Table 3). One important finding from the literature review completed for Seattle's program that is not included in Seattle's or most other existing single-tree credits is to provide stormwater credits for all trees, even if they are not located near impervious surfaces (Capiella 2011).

A few municipalities have implemented stormwater credits for existing or newly planted trees that provide volume reduction, rather than impervious area reduction (Table 3). Washington D.C.'s recently implemented *Stormwater Management Guidebook*, for example, includes tree planting and preservation as a standard stormwater BMP (Center for Watershed Protection and Washington DDOE, 2013). The standard emphasizes that the preferred method for increasing tree cover at a development site is to preserve existing trees during construction, particularly where mature trees are present, and provides a larger volume reduction for tree preservation (20 ft^3 per tree) than for newly planted trees (10 ft^3 per tree). The manual acknowledges that trees also contribute to peak flow reduction, and allows these retention volume credits to be subtracted from the total runoff volumes for the 2-year, 15-year, and 100-year storms. The BMP description includes standard processes for preserving existing trees and for planting new ones, minimum soil volume requirements, strategies for addressing urban planting constraints, and concise tree selection, protection, and maintenance guidelines. Although trees receive retention value under Washington D.C.'s credit, they are not considered total suspended solids (TSS) treatment practices (Table 3). Urban trees to which runoff from impervious surfaces is directed can actually provide significant TSS reduction benefits, as well as nutrient and heavy metal reduction, as shown, for example, in ongoing research by Page et al. (2013) for street trees planted in suspended pavement.

The existing stormwater credits offered for trees at the municipal level almost universally do not give credit for the substantial evapotranspiration benefits provided by trees. Also, none of the credits reviewed recognize the benefits of directing runoff from nearby impervious areas to urban trees (for example, street trees or parking lot trees planted in suspended pavement or structural soil). Directing runoff to trees that are not part of a traditional bioretention BMP can still provide significant soil storage and infiltration. For example, a tree planted with Washington D.C.'s minimum required soil volume of 1500 cubic feet per tree, and the soil has a 20% water holding capacity, that soil volume can hold 300 cubic feet of runoff. This runoff can infiltrate into the underlying soil or be used by the tree. This storage volume is 30 times the amount of credit a newly planted tree is currently awarded in Washington D.C. (Table 3).

Table 3. Examples of municipal stormwater credit programs that include individual trees.

Municipality	Year Enacted	Type of Credit	Distance from Impervious Surface	Credit details and reference link
Pine Lake, GA	2003	Volume reduction	None, applies to all existing or newly planted trees	Provides credit for saving existing trees, regardless of tree position relative to impervious surfaces. Credit helps to meet site runoff requirements and is based on the size of the tree: • Trees < 12" DBH = 10 gallons/inch • Trees > 12" DBH = 20 gallons/inch http://www.pinelakega.com/pdf_docs/Waterfirst_Plan.pdf
Portland, OR	2004	Impervious surface reduction	Within 25 feet	A portion of impervious cover underneath tree canopy may be subtracted from the site impervious cover as follows: • New deciduous trees = 100 ft^2 • New evergreen trees = 200 ft^2 • Existing trees = ½ the existing canopy Credits are accompanied by design criteria and a list of approved species. http://www.portlandonline.com/bes/index.cfm?c=35122&a=55791
Sacramento, CA San Jose and Santa Clara Valley, CA	2007	Impervious surface reduction	Within 25 feet	A portion of impervious cover underneath tree canopy may be subtracted from the site impervious cover as follows: • New deciduous trees = 100 ft^2 • New evergreen trees = 200 ft^2 • Existing trees = ½ the existing canopy Credits are accompanied by design criteria and a list of approved interceptor trees. http://www.sacramentostormwater.org/SSQP/documents/DesignManual/SWQ_DesignManual_May07_062107.pdf http://www.scvurppp-w2k.com/pdfs/1112/C3_Handbook_Chapters-042012-Web.pdf
Indianapolis, IN	2009 (Draft)	Impervious surface reduction	Within 10 feet	An impervious cover reduction credit of 100 ft^2 is given for each new tree. Existing trees are eligible but no reduction is specified. Maximum reduction permitted, including new and existing trees, is 25% of ground level impervious area within the limits of earth disturbance, unless the width of impervious surface area is 10 ft. Narrow impervious areas can be 100% disconnected. New deciduous trees must be at least 2-inch caliper and new evergreen trees must be at least 6 feet tall. Trees must be on approved species list and standards are provided for tree size. http://www.indygov.org/NR/rdonlyres/BE4975CF-9088-4721-9647-6E088015F2B4/0/DRAFT_SWGr eenDoc.pdf
Seattle, WA	2009	Impervious surface reduction	Within 20 feet	Impervious surface reduction credits are as follows: • 50 ft^2 for tree for evergreens • 20 ft^2 for deciduous trees Total tree credit shall not exceed 25% of the total impervious surface requiring mitigation. Newly planted trees must be a minimum of 1.5 inch caliper. Specified tree siting and planting methods must be adhered to. http://www.seattle.gov/DPD/Publications/CAM/cam534.pdf

Municipality	Year Enacted	Type of Credit	Distance from Impervious Surface	Credit details and reference link
Philadelphia, PA	2011	Impervious surface reduction	Within 10 feet (new) or 20 feet (existing)	Reduction in directly connected impervious area granted when new or existing tree canopy from approved species list extends over or is in close proximity to the impervious cover. New trees (min. 2-inch caliper deciduous or 6 ft. tall evergreen): • 100 ft^2 DCIA reduction per new tree. • New deciduous trees must be at least 2-inch caliper and new evergreen trees must be at least 6 feet tall. Existing trees (at least 4-inch caliper): • Existing trees = ½ the existing canopy • Can only be applied to adjacent DCIA Maximum reduction permitted is 25% of ground level impervious area within limits of disturbance, unless impervious area width is less than 10 feet. Up to 100% of narrow impervious areas may be disconnected. http://www.pwdplanreview.org/StormwaterManual.aspx
Washington, DC	2013	Volume reduction	Applies to all existing or newly planted trees	Trees receive retention value but are not considered total suspended solids (TSS) treatment practices. All credited trees must be preserved/planted/properly maintained until redevelopment occurs. If trees die they must be replaced within 6 months. Volume credits are: • Preserved trees: 20 ft^3 each • Planted trees: 10 ft^3 each Trees planted as part of another BMP, such as a bioretention area, also receive the 10 ft^3retention value. A minimum of 1,500 $ft^3$of rootable soil volume must be provided per tree (1,000 ft^3 per tree for planting arrangements with shared rooting space). Rootable soil volume must be within 3 feet of the surface. http://ddoe.dc.gov/sites/default/files/dc/sites/ddoe/page_content/attachments/FinalGuidebook_changes%20accepted_07_19_2013%20Ch.1-7.pdf

In addition to encouraging the preservation of existing individual trees, and the planting of new ones, near impervious areas during development projects, a growing number of municipalities are adopting tree preservation or protection ordinances that are more broadly targeted towards preserving tree cover across entire project sites. A few examples of such ordinances or programs are included in Table 4. These examples were selected to highlight the range of existing tree protection ordinances, and their evolution over time. Some, like the long-standing ordinances in Garland, Texas and Portland, Oregon, require the development and maintenance of a tree inventory and permits for removing existing protected trees. Portland's requirements add the payment of mitigation fees or off-site planting if preservation requirements cannot be met. An ordinance recently passed in the summer of 2013 in Montgomery County, Maryland adds an innovative twist: Not only does their tree preservation ordinance require the replacement and/or planting of a minimum number of trees during development or redevelopment, but it also specifies a minimum volume of soil per tree that is free of any "impediment to root growth and development".

Many of Vermont's larger cities, as well as some smaller communities, have enacted tree protection ordinances that provide a legal framework, authorization, and standards and process for management activities based on how each municipality wants to enhance, maintain and protect its tree population. These ordinances are the legal foundation for each community's programmatic and policy efforts regarding tree planting, protection, maintenance, and removal. The Vermont Urban and Community Forestry Program, in collaboration with the University of Vermont Extension Service, recently released a Guide to Tree Ordinances for Vermont Communities [http://www.vtinvasives.org/sites/default/files/treeordinanceguide.pdf]. While it does not explicitly address the stormwater management benefits of trees, the guide contains a wealth of information about tree ordinance considerations, as well as example ordinance language drawn primarily from existing tree ordinances implemented in Vermont cities and towns.

Table 4. Selected examples of municipal stormwater ordinances and programs that promote preservation or planting of trees at the site or project scale.

Municipality	Year Implemented	Ordinance or program details and reference link
Garland, TX	1991 (rev. 2003)	The City of Garland, Texas enacted a stormwater utility fee system in the early 1990's along with tree protection rules. The tree protection rules include requirements for a permit in order to remove any protected tree, tree inventories for development plans, and tiered percent tree replacement standards based on caliper inches removed and species type. http://www.ci.garland.tx.us/civica/filebank/blobdload.asp?BlobID=5000
Portland, OR	2004	The City of Portland has requirements for minimum canopy coverage through conservation of existing individual trees and planting during development/redevelopment. Requires 1/3 of all trees over 12" diameter to be preserved on site; if preservation cannot be met, then mitigation in form of planting or fee-in-lieu of $1,200 for each tree removed. http://www.portlandonline.com/bes/index.cfm?c=35122&a=55791
Montgomery County, MD	2013 (effective March 1, 2014)	Bill 35-12, Article 2 requires builders to replace trees that are cut down or disturbed during development, and to plant new trees as part of development or redevelopment. Final bill requires that approximately three trees be planted for each single tree that is damaged or removed. Includes a soil volume minimum: "Each shade tree must be allowed at least 400 square feet unless applicable regulations adopted under specify a smaller amount, of open surface area free of any impervious surface, utility, stormwater management system, or other impediment to root growth and development." http://www6.montgomerycountymd.gov/content/council/pdf/bill/2013/20130723_35-12.pdf

The city of Nashville, Tennessee's optional approach to permitting development projects represents a substantial departure from the local credits and requirements for trees described above – yet it also represents a strong and effective incentive for developers to utilize trees and other low-impact strategies for stormwater management. The method was designed to meet the NPDES MS4 Permit one-inch capture requirement (which will be mandatory in 2016), reflect local hydrologic and land conditions, encourage and incentivize the use of natural solutions, be consistent with the current mandated TSS pollutant capture goal, and provide an approach that is simple and effective for the range of development projects occurring in the Nashville Metro area (Nashville Metro Water Services, 2012).

This approach uses LID and runoff reduction principles to mimic local hydrology, which equates roughly to capturing 80% of rainfall on an average annual basis for the HSG C soils that constitute the vast majority (98%) of local soils, and with land cover of trees and grass (the typical Nashville backyard). The approach leads designers through a three-step process: minimize impervious surfaces, preferentially treat runoff from impervious surfaces naturally with sheetflow, and use structures as a last resort:

> *Based on national studies and standards, and supported by local rainfall-runoff analysis for Nashville soils, it was found that an Rv value of 0.20 generally indicates the capture of the first one-inch of rainfall. Storms larger than one inch may cause runoff. Each land use is assigned an Rv value* [see Table 5]. *Once Rv values have been developed, they must be weighted for the respective areas. If the weighted Rv for the whole site is 0.20 or less the standard has been met. If the Rv standard has not been met Green Infrastructure Practices (GIPs) consisting of intrinsic designs and structural controls devised to capture the remaining required volume are added to the design. These effectively modify the Rv value for contributing drainage areas to that intrinsic design or control (Nashville Metro Water Services, 2012).*

Forested cover has a much lower Rv compared to turf or impervious cover, and so trees and disconnection to natural surfaces have become hugely valuable to developers as stormwater management practices (Reese 2013). This approach has proven to be extremely popular with local developers, and although it is still an alternate path to compliance it is almost universally adopted by the development community (Reese 2013).

Table 5. Site cover runoff coefficients (Table 2 from Nashville Metro Water Services, 2012)

Soil Condition	Volumetric Runoff Coefficient (Rv)			
Impervious Cover	0.95			
Hydrologic Soil Group	A	B	C	D
Forest Cover	0.02	0.03	0.04	0.05
Turf	0.15	0.18	0.20	0.23

4. OTHER INCENTIVES APPLICABLE AT THE SITE SCALE

In addition to offering stormwater credits to encourage the use of trees and other green infrastructure practices at the site scale, local governments can use a variety of other incentives applicable to new development or redevelopment projects (U.S. EPA 2009). For new development projects, incentives can be incorporated into existing development processes, such as building permits and stormwater permits, to encourage the use of green infrastructure. In already developed areas, incentives can encourage retrofits of private properties to include green infrastructure practices where they do not already exist. The most frequently implemented local incentive mechanisms include stormwater fee discounts; development incentives; and grants, rebates, and installation financing (U.S. EPA 2009). In nearly all cases, these incentives are offered for a wide suite of green infrastructure practices – but often, trees are not explicitly identified as an eligible GI practice.

4.1. Stormwater fee discounts

Incentives tied to stormwater fees are one of the most common tools used by municipalities across the U.S. to encourage the use of green infrastructure practices. Stormwater fee incentives can be used to encourage both retrofits of existing properties and implementation of green infrastructure in new development (US EPA 2009). Fee discounts provide encouragement for property owners to reduce their stormwater fees by decreasing impervious surfaces or by using green infrastructure techniques that reduce stormwater runoff volumes. As more private property owners manage stormwater runoff on-site, public infrastructure is also less burdened and so less municipal service is required (US EPA 2009).

The City of Philadelphia's restructured stormwater fee system represents a unique example of how tree planting can be encouraged as a stormwater management practice. Formerly, stormwater fees were based on how much municipal drinking water was consumed. In 2010, the Philadelphia Water Department began using GIS imagery to determine the impervious cover of parcels, and property owners are now charged fees based on impervious cover. Homeowners pay a flat fee, while commercial and industrial customers pay based on actual impervious surface. The restructuring led to some significant changes in billing (the airport's bill increased $126,000/month, while the University of Pennsylvania campus now saves $11,000/month) (Arrandale 2012). The water agency now offers up to a 100% fee credit against impervious surface-based fees for the implementation of green infrastructure such as rain gardens, tree planting, rain barrels, wetlands and green roofs (Philadelphia Water Department 2013).

Although they are widely implemented in other parts of the U.S., and especially in major metropolitan areas, stormwater fee discounts currently have limited applicability in Vermont. In order for a fee reduction to be an effective incentive, first a municipality must have a stormwater program or utility that charges a fee for service based on impervious surface area (U.S. EPA 2010). Only two municipalities in Vermont, the cities of Burlington and South Burlington, currently operate stormwater utilities or programs where fees are charged based on impervious surface cover.

4.2. Development incentives

Municipalities may offer special zoning exceptions, expedited permitting, or modified stormwater requirements during the permitting process to encourage the increased use of trees and other GI practices on private property (WERF 2009). Incentives tied to stormwater regulations or permitting processes encourage developers to creatively implement on-site management practices to avoid more stringent or more costly stormwater requirements (U.S. EPA 2010).

One of the most commonly offered development incentives is expedited permitting. Philadelphia, Pennsylvania, for example, has implemented a Green Project Review Program, where redevelopment projects with 95 percent or more of the impervious area disconnected from the combined or separate storm sewer can qualify for an expedited review process (Philadelphia Water Department 2011). Under this program, the stormwater management section of qualifying projects is reviewed within five days of submittal. This option benefits both parties – development projects get time and cost savings, while the incentive has little or no cost for the City (WERF 2009).

The city of Indianapolis, Indiana implemented an expedited review process for designs and plans that that use green infrastructure techniques, as defined in the city's Green Supplemental Document (City of Indianapolis 2009). Permit review for such projects "will be immediately processed and expedited to the greatest extent possible" (City of Indianapolis 2013). While the Green Supplemental Document does contain information and a credit for maximizing tree canopy near impervious cover, it and other non-structural strategies for reducing impervious cover are marked as "under review" and thus are not likely to be used by developers (City of Indianapolis 2009).

Sarasota County, Florida has implemented expedited permitting for projects that meet "green development" standards, including the U.S. Green Buildings Council (USGBC)'s Energy and Environmental Design (LEED) certification program or the Florida Green Building Coalition (FGBC)'s designation standards (Sarasota County, Florida 2006). Such projects are expedited to a greater degree than all other permits throughout all phases of the approval process, including site and development review and building permits (Sarasota County, Florida n.d.). Sarasota County's green building and infrastructure incentives are part of an over-arching sustainability initiative, including a performance goal for all County operations to be carbon-neutral by the year 2030 (Sarasota County 2013).

The City of Chicago's Green Permit Program reviews permits much faster (as few as 30 days, rather than the 60-90 days normally allotted) for projects that meet certain LEED (Leadership in Energy and Environmental Design) criteria that include better stormwater management practices (U.S. EPA 2009). Participants that display a particularly high level of green strategy can have consultant code review fees waived as well (City of Chicago 2012).

4.3. Cost share, tax rebates, or grants for trees and GSI

Rebates and installation financing programs give money directly to individual homeowners, other property owners, and community groups for stormwater-related projects and can help local governments add green infrastructure projects to the landscape (U.S. EPA 2010). Examples of rebates and installation financing include paying back property owners who purchase and plant trees, install rain barrels, or disconnect downspouts from combined systems. There are many examples of successful rebate or cost-share programs for more structural green infrastructure options, such as green roofs, rain barrels/cisterns, or rain gardens. For example:

- Chicago has several green roof incentive programs, including the Green Roof Improvement Fund, a 50% grant match for the cost of placing a green roof on an existing building located in the Central Loop TIF District up to a maximum grant amount of $100,000 per project, and the Green Roof Grant Program, which awards $5,000 grants for green roof projects on residential and small commercial projects (US Department of Energy 2012). These programs have resulted in the addition of over 5 million square feet of green roofs as of 2010 (City of Chicago 2011).

- Seattle's Residential RainWise Program gives residents in targeted CSO watersheds rain garden and cistern construction/installation rebates and technical assistance (Seattle Public Utilities 2013).
- Santa Monica, California, gives $160,000 per year in Landscape Grants to property owners that use native landscaping to reduce water consumption and absorb runoff, as well as a variety of other rebates for green infrastructure including rain barrel/cistern installation, conversion of lawn to native landscaping, and downspout disconnection (City of Santa Monica 2013).

In contrast, there are only a few rebate or cost-share incentive programs that incentivize the planting or preservation of trees where there is a specific recognition of those trees' stormwater-related benefits. Most of these programs are being implemented by states and communities in urbanized areas of the Chesapeake Bay watershed, where Urban Forest Buffers and Urban Tree Planting/Urban Tree Canopy are among the practices that can be credited towards meeting the milestones of individual states' Watershed Improvement Plans under the Chesapeake Bay sediment and nutrient TMDL (Batiuk and Dubin 2013). While most of these programs have been successful getting trees planted, it is crucial to include performance standards for tree and soil quality, soil volume, and tree planting and maintenenance in order to ensure that the trees survive to maturity and for these incentives to be truly effective.

The state of Maryland, for example, launched Marylanders Plant Trees in 2009 "to encourage citizens and organizations to partner with the State to plant new trees" (Maryland Department of Natural Resources 2013). Any resident or landowner can obtain a coupon at www.trees.maryland.gov that is worth $25 off the purchase of one tree with a retail value of $50 or more at all participating retail nurseries and garden centers. The coupon is valid for trees listed on the Marylanders Plant Trees Recommended Tree List. The program has resulted in the planting and registration of over 109,000 trees by November 2013, exceeding the state's goal of 100,000 trees planted by the end of 2013 (Maryland DNR 2013).

Under the Rain Check Rebate Program in Prince Georges County, Maryland, shade trees planted on private property (homeowners, businesses, and nonprofit entities including housing cooperatives and churches) are eligible for rebate of some implementation costs (Prince Georges County MD 2012). Rebates of $150/tree (up to $1,200/lot) are available to single-family residences or individual members of housing cooperatives; rebates of $150/tree (up to $1,800/lot) are available to commercial, multi-family dwellings, nonprofits, not-for-profit organizations, and housing cooperatives. Although shade trees are practices eligible for rebate, they are not clearly identified in application forms as also being BMPs eligible for reductions in the County's Impervious Surface Fees (Prince Georges County MD 2012).

In Delaware, the Delaware Forest Service and DNREC's Division of Watershed Stewardship partnered to offer the "Trees for the Bay" program in 2013, where free trees were offered with the (discounted) purchase of one or more rain barrels for Delaware residents of Chesapeake Bay communities (Delaware Urban and Community Forestry Program 2013). During rain barrel sale events in the month of April, those who lived in eligible zip codes received a voucher worth $125 toward the purchase of a qualifying tree at participating nursery and garden centers. Urban Tree Planting (Urban Tree Canopy) is included as a BMP in Delaware's Phase II WIP, with a goal of maintaining the existing 99 acres of urban tree planting (Delaware NREC 2012).

In Pennsylvania, TreeVitalize is a public-private partnership started in 2004 to help restore tree cover, particularly in urban portions of the Chesapeake Bay watershed area of southeast Pennsylvania (Pennsylvania DCNR 2013). Its coupon program ($15 off the retail purchase of an eligible tree costing $50 or more) is similar to that operated in the state of Maryland. TreeVitalize has planted over 350,000 trees through the help of many partners and interested community volunteers (Pennsylvania DCNR 2013).

In ultra-urban areas, like Philadelphia and Washington, D.C., grants and other financial incentives that target trees are often for BMPs like tree trenches rather than for the planting of individual trees. The Philadelphia Water Department, for example, created the Stormwater Management Incentives Program (SMIP) to provide assistance to non-residential PWD customers (Philadelphia Water Department 2013). This competitive program offers reimbursement grants of up to $100,000 per impervious acre managed, and is restricted to projects that support the design and construction of stormwater mitigation measures including detention and retention basins, tree trenches, green roofs, porous paving, and rain gardens. In Washington, D.C. a range of grants and incentives are offered for property owners to install green infrastructure on District, residential, and commercial buildings, including subsidy programs for the installation of rain barrels, shade trees, rain gardens, and pervious pavers (Washington D.C. DDOE 2013). The District's incentives include:

- RiverSmart Homes Program (single family homes)
- RiverSmart Communities Program (larger properties such as apartments, churches, condos, and businesses)
- RiverSmart Rooftops Program
- Rain Barrel Rebate
- Shade Tree Rebate
- Rain Garden and Installation of Pervious Pavers Rebate

Washington D.C. is also establishing a Stormwater Retention Credits (SRC) market, in which land owners who are able to implement on-site retention, infiltration, evapotranspiration or reuse above the required standard can sell their surplus credits to other developers in the district who may find meeting the standard to be too costly, or infeasible (Washngton D.C. DDOE 2013).

5. RECOMMENDATIONS FOR SITE SCALE TREE CREDITS IN VERMONT

A successful system for incentivizing the use of trees as components of an effective stormwater management system at the site scale, given Vermont's conditions and regulatory infrastructure, should take into account both the current science and national developments described in this paper and the following key themes gathered during interviews of national tree experts and Vermont regulators, local officials, and other local stakeholders:

- Large, healthy trees provide significantly more stormwater benefits. For any tree credit system to be effective, standards for tree and soil quality, soil volume, and tree installation and maintenance are crucial. These components help ensure the magnitude of benefits trees are able to provide at maturity.
- Trees provide many other benefits in addition to stormwater benefits, such as energy benefits (significant reduction of energy needed for heating in cold climates), and economic benefits. Cost benefit analysis of trees to evaluate costs and benefits over the life of the tree can be a powerful tool to illuminate the value of trees.
- The best and most well-understood opportunities for explicitly incorporating trees into stormwater BMP designs are in ultra-urban areas.
- In ultra-urban areas, trees are most effective where the canopy will extend over existing impervious surface and is therefore able to intercept rainfall that would otherwise be direct runoff–but the stormwater benefits of trees over pervious and especially uncompacted soil cannot be neglected.
- Well-designed tree-based systems in urban areas are capable of receiving/treating runoff from adjacent areas, as opposed to simply treating the rainfall that falls on a particular area.
- Adding trees in areas that are devoid of trees – including commercial and industrial areas – would provide the greatest stormwater management benefits.
- Smaller urban sites are often well-suited for tree-based practices, because more traditional stormwater management measures can be difficult to fit.

There are three major areas in Vermont's regulatory framework where practices and incentives for trees are both applicable and relevant:

1. The Vermont Department of Environmental Conservation Stormwater Program issues permits for post-development runoff from impervious surfaces, as well as for construction site disturbance and for industrial facilities. These regulatory programs, and companion guidance documents including the Vermont Stormwater Management Manual (VSMM), explicitly regulate stormwater management at the site or project scale. The Stormwater Program is currently (in 2013-2014) working to revise the VSMM (see http://www.vtwaterquality.org/stormwater/htm/sw_manualrevision.htm). This process represents the best and most timely opportunity to improve the use of trees, minimal site disturbance, soil restoration, and other tree-related practices across Vermont.
2. As outlined in this paper, site-scale tree-related incentives are actively being tracked and utilized as a component of the implementation of large-watershed nutrient TMDLS such as the

Chesapeake Bay watershed nitrogen TMDL. Careful consideration should be given to the use of site scale practices and incentives that include trees as part of Vermont's TMDL implementation strategies – whether for the Lake Champlain phosphorus TMDL, the Long Island Sound nitrogen TMDL (especially as concern rises over the Connecticut River's potential nutrient contributions to the Sound), or for stormwater-related TMDLs and related Flow Restoration Plans in Vermont's urban stormwater-impaired watersheds. Site-scale incentives for trees would be of utility in all these TMDLs and implementation efforts, but since quantitative assessment of trees' benefits (whether at the site or watershed scales) has not been a part of the process to date, it is difficult to incorporate them in meaningful ways during implementation.

3. Vermont has a strong and robust tradition of local control of land-use decision making, which is exemplified in Town Plans, zoning and subdivision ordinances, land development regulations, and other policy documents. However, in some instances, local land use regulations contain requirements that may conflict with state and local policies that aim to foster philosophies of site development that minimize disturbance and maximize the implementation of "green infrastructure"—including the preservation or planting or trees. The Vermont League of Cities and Towns has made some early steps to encourage municipalities to include LID and/or green stormwater infrastructure in local ordinances, including providing a model bylaws and technical assistance (see http://www.vlct.org/municipal-assistance-center/water-resources-assistance/). The nexus between site planning and green infrastructure at the local level should be a key consideration in any strategy for increasing the consideration of tree-related stormwater management practices at the site scale – especially since many small, local construction projects create disturbance that is collectively substantial, yet individually never rises to the level of requiring a state-level construction or post-construction stormwater management permit.

Despite the challenges inherent in accurately accounting for the stormwater management benefits of trees at the individual tree to site scale, permitting practices and accounting systems that include—and even emphasize—trees are being developed and implemented in both temperate and cold-climate regions of the United States. The Vermont DEC Stormwater Program's current effort to update the VSMM represents a critically important opportunity to foster the development of performance standards and/or crediting systems that explicitly consider the retention or planting of trees at the individual tree to site scale during the site development or redevelopment process in the state.

6. REFERENCES

Arrandale, Tom. 2012. The Price of Greening Stormwater. In Governing: The States and Localities, April 20, 2012. Accessed at http://www.governing.com/topics/energy-env/price-greening-stormwater-philadelphia.html on November 5, 2013.

Batiuk, Rich, and Mark Dubin. 2013. Chesapeake Bay Commission Meeting, Briefing Paper Part #1: Calculating Reductions: What Counts and What Doesn't? Paper dated September 20, 2013. Accessed at http://www.chesbay.us/Presentations/September%202013/CBC%20Sept%2020%202013%20Mtg%20What%20Counts%20Briefing%20Paper.pdf on November 11, 2013.

Cappiella, Karen, Tom Schueler, and Tiffany Wright. 2005. Urban Watershed Forestry Manual, Part 1: Methods for Increasing Forest Cover in a Watershed. Report no. NA-TP-04-05, prepared by the Center for Watershed Protection for the USDA Forest Service, Northeastern Area, July 2005. Accessed at http://www.treesearch.fs.fed.us/pubs/19916 on November 13, 2013.

Cappiella, Karen, Tom Schueler, and Tiffany Wright. 2006. Urban Watershed Forestry Manual Part 2: Conserving and Planting Trees at Development Sites. Report no. NA-TP-01-06, prepared by the Center for Watershed Protection for the USDA Forest Service, Northeastern Area, May 2006. Accessed at http://www.treesearch.fs.fed.us/pubs/19936 on November 13, 2013.

Cappiella, Karen, Tom Schueler, and Tiffany Wright. 2006. Urban Watershed Forestry Manual, Part 3: Urban Tree Planting Guide. Prepared by the Center for Watershed Protection for the USDA Forest Service, Northeastern Area, March 2006. Accessed at http://www.na.fs.fed.us/pubs/uf/watershed3/urban_watershed_forestry_manual_part3.pdf on November 13, 2013.

Cappiella, Karen. 2011. Runoff Ramblings: Trees as Stormwater BMPs. Center for Watershed Protection Runoff Rundown newsletter, published Spring 2011. Accessed at http://archive.constantcontact.com/fs045/1101639006674/archive/1105190238712.html on April 2, 2013.

Center for Watershed Protection and US Forest Service - Northeastern Area. 2008. Watershed Forestry Resource Guide: Using Trees to Reduce Stormwater Runoff. Web page updated 2008. Accessed at http://www.forestsforwatersheds.org/reduce-stormwater/ on April 23, 2013.

Center for Watershed Protection and US Forest Service - Northeastern Area. 2008. Stormwater Credits. Web page updated 2008. Accessed at http://www.forestsforwatersheds.org/storage/stormwater%20credits.pdf on April 23, 2013.

Center for Watershed Protection. 2013. Stormwater Management Guidebook. Prepared for the Washington, D.C. District Department of the Environment, Watershed Protection Division by the Center for Watershed Protection, June 2013. Accessed at http://ddoe.dc.gov/sites/default/files/dc/sites/ddoe/page_content/attachments/FinalGuidebook_changes%20accepted_07_19_2013%20Ch.1-7.pdf on November 11, 2013.

City of Chicago, Illinois Housing and Community Development. 2011. Chicago Green Roofs web page, updated May 2011. Accessed at http://www.cityofchicago.org/city/en/depts/dcd/supp_info/chicago_green_roofs.html on November 11, 2013.

City of Chicago (Illinois) Department of Construction and Permits. 2012. Overview of the Green Permit Program. Web page updated November 2012. Accessed at http://www.cityofchicago.org/city/en/depts/bldgs/supp_info/overview_of_the_greenpermitprogram.html on November 11, 2013.

City of Indianapolis, Indiana. 2009. Stormwater Design and Specification Manual, Draft Green Infrastructure Supplemental Stormwater Document. Effective April 2009. Accessed at http://www.indy.gov/eGov/City/DPW/SustainIndy/WaterLand/Documents/Final.pdf on November 11, 2013.

City of Indianapolis, Indiana. 2013. Sustainable Infrastructure web page. Accessed at http://www.indy.gov/eGov/City/DPW/SustainIndy/WaterLand/Pages/SustainableInfrastructure.aspx on May 30, 2013.

City of Nashville, Tennessee, Metro Water Services. 2013. Low Impact Development web page. Accessed at https://www.nashville.gov/water-services/developers/low-impact-development.aspx on October 15, 2013.

City of Santa Monica, California Office of Sustainability and the Environment. City of Santa Monica Landscape Rebates web site. Page updated October 30, 2013. Accessed at http://www.smgov.net/departments/ose/ on November 11, 2013.

Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation. 2013. Delaware's Chesapeake Bay Watershed Implementation Plan (WIP). Web page updated March 2013. Accessed at http://www.dnrec.delaware.gov/swc/wa/Pages/Chesapeake_Wip.aspx on November 12, 2013.

Delaware Urban and Community Forestry Program. 2013. “Trees for the Bay” web page. Page updated May 2013. Accessed at http://delawaretrees.com/trees-for-the-bay/ on November 11, 2013.

Maine Department of Environmental Protection. 2009. Maine Stormwater Best Management Practices Manual. Web page. Accessed at http://www.maine.gov/dep/land/stormwater/stormwaterbmps/ on October 16, 2013.

Maryland Department of Environment and the Center for Watershed Protection. 2000. Maryland Stormwater Design Manual, Volumes I and II. Effective October 2000, Revised May 2009. Accessed at http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual/Documents/www.mde.state.md.us/assets/document/appendixd1.pdf on October 16, 2013.

Maryland Department of Natural Resources. 2013. Marylanders Plant Trees web site. Page updated January 2013. Accessed at http://www.trees.maryland.gov/index.asp on November 12, 2013.

Massachusetts Department of Environmental Protection. 2008. Massachusetts Stormwater Handbook. Revised February 2008. Accessed at http://www.mass.gov/dep/water/laws/policies.htm#storm on August 13, 2012.

Metro Water Services (Nashville, Tennessee). 2012. Metropolitan Nashville – Davidson County Stormwater Management Manual Volume 5: Low Impact Development Stormwater Management Manual. Effective June 2012. Accessed at https://www.nashville.gov/portals/0/SiteContent/WaterServices/Stormwater/docs/SWMM/vol5/SWMM_Vol5LIDManual_2012.pdf on November 5, 2013.

Midwest Urban Tree Canopy Project. 2011. The Value of Urban Trees: Stormwater Management. Web page last updated 2011. Accessed at http://midwestutc.org/stormwater.aspx on April 24, 2013.

Minnesota Stormwater Steering Committee. 2013. The Minnesota Stormwater Manual. Effective Page updated September 2013. Accessed at http://stormwater.pca.state.mn.us/index.php/Main_Page on October 16, 2013.

Minnesota Pollution Control Authority. 2013. Minnesota Stormwater Manual – Trees Overview page. Page last modified October 31, 2013 Accessed at http://stormwater.pca.state.mn.us/index.php/Trees on November 6, 2013.

Minnesota Pollution Control Authority. 2014. Minnesota Stormwater Manual: Calculating credits for tree trenches and tree boxes. Page last modified January 31, 2014. Accessed at http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_tree_trenches_and_tree_boxes on February 28, 2014.

New Jersey Department of Environmental Protection. 2004. New Jersey Stormwater Best Management Practices Manual. Dated February 2004, revised September 2009. Accessed at http://www.njstormwater.org/bmp_manual2.htm on October 16, 2013.

New York State Department of Environmental Conservation. 2010. New York State Stormwater Management Design Manual. Revised August 2010. Accessed at http://www.dec.ny.gov/docs/water_pdf/swdm2010entire.pdf on July 12, 2013.

Page, J.L., R.J. Winston, and W.F. Hunt, III. 2013. Draft Field Monitoring of Two Silva Cell™ Installations in Wilmington, North Carolina: Preliminary Monitoring Report. As cited in Shanstrom, Nathalie. 2014. Final Results of NCSU Stormwater Treatment Performance Monitoring. Web page dated January 8, 2014. Accessed at http://www.deeproot.com/blog/blog-entries/final-results-of-ncsu-stormwater-treatment-performance-monitoring on February 28, 2014.

Pennsylvania Department of Environmental Protection, Bureau of Watershed Management. 2008. Pennsylvania Stormwater Best Management Practices Manual. Revised December 30, 2008. Accessed at http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305 on August 13, 2013.

Philadelphia Water Department. 2011. Stormwater Management Guidance Manual, Version 2.0. Prepared by the Philadelphia Water Department, Planning & Environmental Services Division, revised April 29, 2011. Accessed at http://www.pwdplanreview.org/StormwaterManual.aspx on November 11, 2013.

Philadelphia Water Department. 2013. Stormwater billing: where can I find more information? Web page last updated 2013. Accessed at http://www.phila.gov/water/Stormwater_Where.html on November 5, 2013.

Philadelphia Water Department. 2013. Stormwater Management Incentives Program Grant Fact Sheet. Accessed at http://www.phillywatersheds.org/doc/SMIP_Grant_Factsheet_FY13.pdf on May 30, 2013.

Prince Georges County, MD. 2012. Urban Tree Canopy Fact Sheet and Planting Guidance. Accessed at http://www.princegeorgescountymd.gov/sites/StormwaterManagement/CleanWaterActFees/BMP/TreeCanopy/Pages/default.aspx on November 12, 2013.

Reese, Andrew. 2013. Volume-Based Design Criteria – Flaws and Potential Solutions. Presented at the International Low Impact Development Symposium, St. Paul, Minnesota, August 18-21, 2013. Accessed at http://www.cce.umn.edu/Documents/CPE-Conferences/LIDS/LIDS-Final-Program-Book.pdf on October 15, 2013.

Reese, Andrew. 2013. Not simpler than possible. Stormwater, July-August 2013. Accessed at http://www.stormh2o.com/SW/Articles/Not_Simpler_Than_Possible_22456.aspx on October 15, 2013.

Rhode Island Department of Environmental Management and Coastal Resources Management Council. 2011. Rhode Island Stormwater Design and Installation Standards Manual. Revised December 2010, effective January 1, 2011. Accessed at http://www.dem.ri.gov/pubs/regs/regs/water/swmanual.pdf on July 9, 2012.

Sarasota County, Florida. 2006. Resolution of the Board of County Commissioners of Sarasota County, Florida #2006-174: Green Building and Green Development. Adopted August 22, 2006. Accessed at https://www.scgov.net/Sustainability/County%20Does/Green%20Development%20Resolution%202006-174.pdf on November 11, 2013.

Sarasota County Office of Business and Economic Development. n.d. Sarasota County, Florida Economic Development Incentive Programs brochure. Accessed at https://www.scgov.net/EconomicDevelopment/Documents/Incentive%20Brochure.pdf on June 7, 2013.

Sarasota County, Florida Planning and Development Services. 2013. Sustainability: What the County Does web page. Page updated 2013. Accessed at https://www.scgov.net/Sustainability/Pages/County.aspx on November 11, 2013.

Seattle Public Utilities. 2013. RainWise Rebates web page. Page updated 2013. Accessed at https://rainwise.seattle.gov/city/seattle/overview on November 11, 2013.

Shanstrom, Nathalie. 2013. How Do You Calculate Stormwater Credits for Trees? Part 1: Why tree-based credits are hard to quantify. Posted on March 25, 2013. Accessed at http://www.deeproot.com/blog/blog-entries/how-do-you-calculate-stormwater-credits-for-trees-part-1-why-tree-based-credits-are-hard-to-quantify on April 2, 2013.

U.S. Department of Energy, Building Energy Codes Program. 2012. Green Roof Improvement Fund (Chicago, IL 2006). Web page last updated August 21, 2012. Accessed at http://www.energycodes.gov/resource-center/policy/green-roof-improvement-fund-chicago-il-2006 on November 11, 2013.

U.S. Environmental Protection Agency. 2009. Managing Wet Weather with Green Infrastructure Municipal Handbook: Incentive Mechanisms. EPA-833-F-09-001, dated July 2009. Accessed at http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_munichandbook_incentives.pdf on June 7, 2013.

U.S. Environmental Protection Agency. 2010. Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure. Document number EPA-841-F-10-004, August 2010. Accessed at http://www.epa.gov/owow/NPS/lid/gi_case_studies_2010.pdf on June 5, 2013.

Vermont Department of Environmental Conservation. 2002. The Vermont Stormwater Management Manual, Volume I – Stormwater Treatment Standards. Effective April, 2002. Accessed at http://www.anr.state.vt.us/dec/waterq/stormwater/docs/sw_manual-vol1.pdf on September 19, 2013.

Vermont Urban and Community Forestry Program. 2013. Guide to Tree Ordinances for Vermont Communities. Vermont Department of Forests, Parks and Recreation in partnership with the University of Vermont Extension, January 2013. Accessed at http://www.vtinvasives.org/sites/default/files/treeordinanceguide.pdf on October 22, 2013.

Washington D.C. District Department of the Environment (DDOE). 2013. District of Columbia Green Financial Incentives. Fact sheet dated Spring, 2013. Accessed at http://rrc.dc.gov/green/lib/green/pdfs/Green_Incentives.pdf on October 31, 2013.

Washington D.C. District Department of the Environment. 2013. District of Columbia Municipal Regulations, 2013 Rule on Stormwater Management and Soil Erosion and Sediment Control. Effective July 19, 2013. Accessed at http://ddoe.dc.gov/node/610592 on October 14, 2013.

Washington Department of Ecology. 2012. Stormwater Management Manual for Western Washington. Publication Number 12-10-030, Effective August 1, 2012. Accessed at https://fortress.wa.gov/ecy/publications/publications/1210030.pdf on August 22, 2012.

Water Environment Research Foundation (WERF). 2009. Using Rainwater to Grow Livable Communities: Using Incentive Programs to Promote Stormwater BMPs. Prepared by Wenk Associates and Tetra Tech, updated December 2009. Accessed at http://www.werf.org/liveablecommunities/toolbox/incentives.htm on June 7, 2013.