A Guide for Forestry Practices in the Chesapeake TMDL

Phase III WIPs

Prepared by the Forestry Workgroup, Chesapeake Bay Program Office

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Contents

Introduction

Compared to developed and farm land, forest land cover is by far more beneficial to water quality, it has long been a tenet of Bay restoration to maintain as much forest cover as possible. Along with forest retention, new forest establishment is one of the most cost-effective Bay restoration best management practices (BMPs). In addition, we know forest BMPs provide more co-benefits (for fish, wildlife, recreation, for air quality, human health, etc.) than most other BMPs as reflected in a recent report. This draft guide shows the value of forests and tree planting to state and local partners involved in developing and implementing Phase III Watershed Implementation Plans (WIPs) for the Chesapeake Bay TMDL. The Forestry Workgroup wanted to get this out early in the WIP process, so revisions are expected and comments are welcome.

The Phase III WIPs are due to be completed in 2018 as part of the requirements set out by EPA and the Chesapeake Bay partnership. This guide conveys information about the various forestry BMPs in the Chesapeake Bay model including opportunity and reporting protocols. Examples of forest BMP scenarios are provided to show partners what information is available, where to find it and how to use it. The document will illustrate the benefits of retaining forest and tree cover.

The forestry BMPs covered in this document are:

- Urban Forest Buffers
- Urban Tree Canopy Expansion
- Urban Forest Planting
- Agricultural Riparian Forest Buffers
- Agricultural Tree Planting
- Forest Harvest Practices

Phase III WIP Expectations

EPA released its Interim Phase III WIP Expectations in January 2017, with guidance from the Chesapeake Bay partnership. When developing Phase III WIPs, states should:

- Include strategies for cooperating at the local, regional and federal levels to implement BMPs
- Consider the corollary (supplementary) benefits of targeted BMPs, outside of water quality improvements
- Account for population growth and development

The partnership expects Phase III WIPs to provide a strong foundation for success, built on government leadership, strategically aligned federal-state-local priorities, strong networks, and sufficient financial and programmatic capacity. Planning targets (load reductions) for Phase III will be approved by the Principal Staff Committee in late 2017 or early 2018.

Phase 6 Model

Phase 6 of the Chesapeake Bay model went live in June 2017. Phase 6 is different from Phase 5 in these notable ways:

- It combines a series of outside models and will be run through CAST.
- high-resolution imagery combined with LiDAR to more accurately detect land uses;
- Land uses are now denoted as load sources. Load sources are a more appropriate designation since there are loads that do not have land area (e.g., streams).
- BMPs must be input for an agency, load source and a geographic location. Geographic locations can be general like a state, or specific like a hydrologic unit code (HUC).
- Phase 5.3.2 had edge-of-stream (EOS) loads for big streams (approximately a 3rd order stream or larger) and the delivered (DEL) load to the Chesapeake Bay. The new version will have edge-of-small stream loads (EOS) and the delivered load to the tidal portion of the Chesapeake Bay (EOT).
- A number of agricultural updates have been added.

CAST

CAST, the Chesapeake Assessment Scenario Tool, is now the same software and database as the Chesapeake Bay model. This means that using CAST to model BMPs in your jurisdictions will generate the most accurate and up-to-date results according to Chesapeake Bay Program (CBP) data. More information about pollution reduction strategies will be available in CAST soon. For instance, plans are underway to develop an optimization module for users to calculate the cost of a BMP per pound of nutrients reduced.

States can use the CAST tool at the state, county, or watershed level to view the cost-effectiveness and load reduction of specific BMPs added by acre or percent value. Jurisdictions can view the effect of adding a BMP in a specific county. The CAST homepage also hosts valuable source data including land use distribution, BMP definitions and load calculation information.

CAST also offers a prepared E3 ("Everyone, Everywhere, Everything") scenario which can be tested against base year scenarios to determine which counties have the most opportunity for implementing certain BMPs. These can be a valuable tool for states looking to prioritize certain geographic areas.

The following information can be downloaded using CAST:

- Reports on reported/credited BMP acres in any given year
- Reports comparing BMPs in an E3, No Action or actual scenario
- County-level and state level land use data
- Load reductions of implementing specific BMPs in a specified jurisdiction

The Importance of Forest Retention

Retention of forested land is critical for water quality and nutrient management in the Chesapeake watershed. While not a BMP per se, the water quality benefits and cost savings associated with retaining forests on the landscape cannot be understated. Urban centers in the watershed face some of the highest development prospects in the nation. Land conservation and planning practices should be considered when "accounting for growth" in state and local Watershed Implementation Plans (WIPs). Alternative future scenarios that account for forest retention, increased conservation efforts, and changes in zoning can be contrasted to a 2025 land growth projection scenario (aka, no action or anticipated growth). Only new conservation and zoning changes will be considered to alter the projection of future growth. The partnership adopted a 2025 geospatial analysis that, among other things projected where forest loss is likely to occur.

A recent study conducted by the Virginia Department of Forestry, the Healthy Watersheds Goal Team and others found that scenarios that retained forest in the Rappahannock River basin saved the region $125 million by avoiding the need for watershed restoration practices.

In Phase 5 of the model, there is a BMP called Forest Conservation. This is different than having permanently protected forest and also different from forest retention. More on the Forest Conservation BMP can be found on page 19, but since there is now a Forest Planting BMP in Phase 6, and better accounting of forests and growth projections, the Forest Conservation BMP is likely to be phased out.

Forecasting Land Use

States can learn about their projected acres of forest loss by using CAST. The Chesapeake 2025 Projected Land Growth Model will be uploaded to CAST in July-August 2017 timeframe. This information will also be available on USGS's high-resolution land use viewer. For baseline 2025 land use, Phase 6 model will either use the projected 2025 land use or 2014 land use. The final decision will be made by the Principal Staff Committee in the fall of 2017. Either way, states should use the 2025 forecast to predict forest loss and the additional BMPs that will be needed to compensate for it. No matter which baseline is chosen, states will benefit from retaining as much forested land as possible.

States should pay attention to their existing forested acres in the Bay model, and how and where forest loss is projected. The 2025 land use projections are available now in the attached document, "2025 Land Use Projections by County," but have not been added to CAST as of July 2017. States can compare projected land use with the land use data available in CAST*, to determine which counties face the most development and potential forest loss by 2025.

We can use the current land use and 2025 projected land use to predict that Spotsylvania County, VA will face a much higher forest loss than Hanover County, VA in the example below.

Example: Forest Loss Acres Projected in Two Virginia Counties

County	**Forested Acres (2013)**	**Forested Acres (projected 2025)**	**Forest Loss 2013-2025 (Ac)**	**% Forest Loss 2013-2025**
Spotsylvania (VA)	172,396	160,357	12,039	6.9%
Hanover (VA)	161,446	160,682	764	0.4%

*This data has been made available in the attached document, "CAST County Land Use 2013"

Relative Forest Value

States and localities should consider the degree of value for retaining specific forest acres. Forested acres vary in value and nutrient trapping capability depending on their location, composition, and surrounding area. States should plan to prioritize high-value acres when planning for forest retention, but work on retaining all forests.

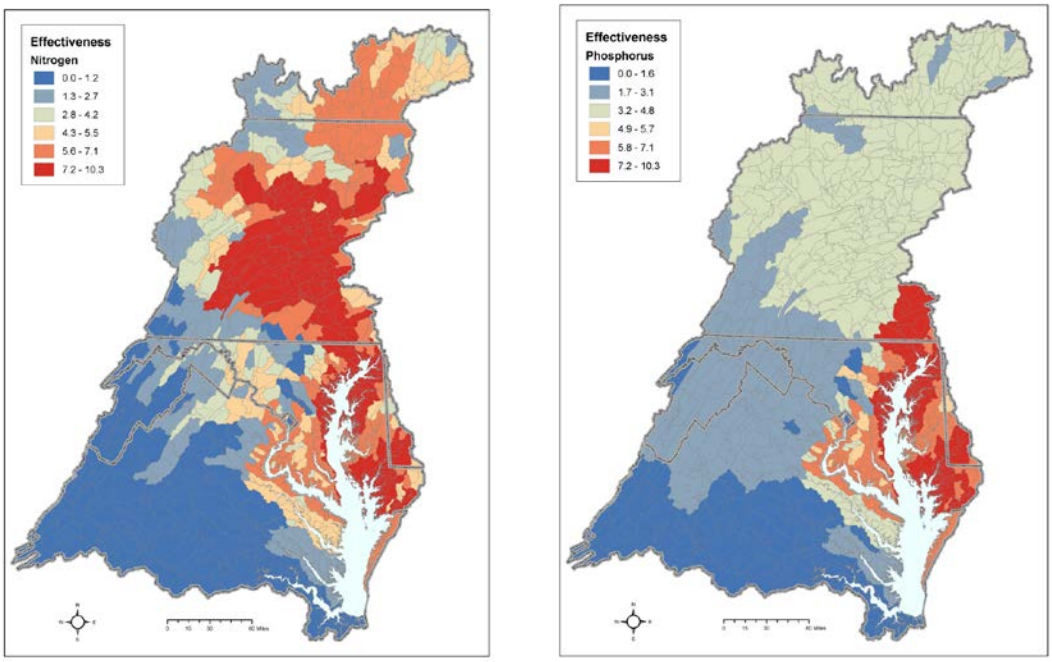


Figure 2. Maps showing relative effect of a pound of pollution on Bay water quality (draft data from J Sweeney)

Tools for Limiting Growth

Some local governments in the watershed have implemented policies to limit growth or direct it away from forested lands. These policy tools can include a Transfer and Purchase of Development Rights, in which development is capped but developers can purchase rights from landowners who chose to conserve their forest. A June 2017 report from the Chesapeake Bay Trust, entitled "Conservation Land-Use Policy Toolkit," lays out different policy options for conserving valuable land, including forests. Other policy tools to help retain forests in Virginia and Pennsylvania are described in a recent Bay report on Healthy Forest Retention Study by the Virginia Department of Forestry. Jurisdictions should use these and other resources to identify effective options for conserving land and retaining forests.

Urban Forestry BMPs

Urban Forest Buffers

Urban Forest Buffer	
Definition:	Forest buffers are linear wooded areas that help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width is 100 feet, with a 35 feet minimum width.
Efficiency Credited	TN: 25%, TP: 50%. TSS: 50%
Total Annual Cost per Acre (Watershed-wide Avg.)	$86.17
Narrow Buffers Only (Urban)	Linear strips of wooded areas between 10 and 35 feet in width.
Efficiency Credited	Land conversion to forest only

Description

Buffers in urban areas have a different efficiency than agricultural buffers —because impervious surfaces routing flow away from riparian areas, they have a lower an efficiency (equivalent to a land use change and are not expected to treat upland runoff).

Progress and Opportunity

Urban Forest Buffers BMP Acres Reported 1990-2013 (no record for states not shown)

State	**1990**	**1995**	**2000**	**2005**	**2010**	**2013**
MD	11.7	16.9	21.5	24.4	74.2	121.9
VA	5	0	0	18.3	34.7	29.5
WV	0	0	0	0	6.1	14.1

Urban riparian forest buffers can be constructed on turf grass that is adjacent to a river or stream. From the new high resolution land cover data, the Bay Program has a good idea how many acres of riparian turf are available for conversion to forest. For instance, in Delaware, Sussex County has the highest opportunity for urban riparian buffer (see below). States should look to conserve the “Natural” land in the riparian zone because only a net gain in buffers can be counted. Land use data can be accessed in the spreadsheets in the attached document “State Tree Cover and Buffer Data.”

County Name	**Total Area 10m**	**Turf Grass (10m)**	**Natural 10m (Ac)**
Kent	7927	470	4931
New Castle	1514	73	896
Sussex	18792	1238	11129

E3 Potential

By generating a CAST "BMP Summary Report" comparing the "2013 Progress" and "E3 with Allocated Air" scenarios, states can find out the most opportune counties in which to place certain BMPs. For example, a report on Kent, Sussex, and New Castle Counties in Delaware tells us that Sussex County has the most opportunity for Urban Forest Buffers, with 1694 acres possible in a 10m E3 scenario. The E3 number is higher than the turf grass number because it includes other land use categories such as 'mixed open.'

BMP	unit	New Castle		Sussex		Kent	
		2013	E3	2013	E3	2013	E3
Urban Forest Buffers	acres	0	1366	0	1694	0	1140

Urban Tree Canopy Expansion

Urban Tree Canopy Expansion	
Definition:	Tree plantings on developed land (impervious or turf grass) that result in an increase in tree canopy but are not intended to result in forest-like conditions
Efficiency Credited	Land use change
Credit Expiration	10 years and then it is picked up as Land Use
Total Annual Cost per Acre (Watershed-wide Avg.)	$66.75
Reference	Expert Panel Report

Description

Credit for the Urban Tree Canopy Expansion BMP is based on the number of individual trees planted with a conversion to equivalent acres for reporting purposes. The credit for this practice was recently updated (see Expert Panel Report). A credit of 144 ft^2 per tree planted is equivalent to 300 trees planted per acre; however this is not a planting density requirement. Thus, each newly planted tree converts 1/300 an acre of either pervious or impervious developed area to tree canopy land uses. The relative nitrogen, phosphorus and sediment load reductions are applied to the underlying land use and applied to creditable area. This BMP does not require trees to be planted in a contiguous area.

Tree Canopy Expansion over impervious surfaces (TCI) offers more load reduction than expanding canopy over turf grass (TCT). States should prioritize TCI opportunities. However, Forest Planting on turf grass provides the most water quality benefit (see the "Urban Forest Planting" BMP, below).

Progress and Opportunity

Urban Tree Canopy Expansion BMP Acres Reported 1990-2013

State	1990	1995	2000	2005	2010	2013
DE	0	0	0.2	0.3	0.5	1.1
WV	0	0	0	0	2.5	12.2
DC	9	25	43	73.3	113.8	155.2
PA	0	0	0	0	0	33.3

Urban Tree Canopy can be planted in areas of turf grass. In Pennsylvania, for example, Lancaster County has a greater amount of turf available for Urban Tree Canopy Expansion than Lebanon or Luzerne Counties (see below). *States should ensure that tree canopy expansion does not occur at the expense of forest.*

Example: Turf grass acres in select Pennsylvania counties

County Name	Total Area (ac)	Acres of Tree Canopy Over Imp. (TCI)	Acres of Tree Canopy Over Turf (TCT)	Total Turf (ac)
Lancaster	627599	4705	23759	99662
Lebanon	197724	1292	6064	22732
Luzerne	494988	3874	17268	31091

Urban Forest Planting

Urban Forest Planting	
Definition:	Urban forest planning includes any tree planting except those used to establish riparian forest buffers. Trees are planted on pervious areas. Enter units of acres or percent.
Efficiency Credited	Land use change
Credit Expiration	10 years and then it is picked up as land use
Total Annual Cost per Acre (Watershed-wide Avg.)	$82.57
Reference	Expert Panel Report

Description

The Urban Forest Planting BMP refers to tree planting projects in urban or suburban areas that are not part of a riparian buffer planting, structural BMP (e.g., bio-retention, tree planter) or Urban Tree Canopy Expansion BMP. This BMP offers more load reduction benefits than Urban Tree Canopy Expansion.

Forest Planting is a land use change BMP and receives the water quality benefit of converting turf grass to forest. This is significantly more credit than tree canopy expansion primarily because the understory is not managed. Under this BMP, trees are planted in a contiguous area.

This BMP is implemented with the intent of establishing forest or similar ecosystem processes and function. This requires that urban forest plantings be documented in a planting and maintenance plan that meets state planting density and associated standards for establishing forest conditions, including

no fertilization and minimal mowing as needed to aid tree and understory establishment. Trees planted as part of Urban Tree Canopy Expansion will not be credited as Urban Forest Planting.

Progress and Opportunity

Urban Forests are usually planted on turf grass. See chart below for total acres of turf in developed land available using Delaware as an example. Information for other states is provided in attached database file.

County Name	Total Area	Total Turf (Ac)
Kent	129866	10742
New Castle	29250	4421
Sussex	294557	26817

Agricultural Forestry BMPs

Riparian Forest Buffers (Agricultural)

Riparian Forest Buffer	
Definition:	Forest buffers are linear wooded areas that help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width is 100 feet, with a 35 feet minimum width required. Enter units of acres or percent.
Efficiency Credited	Land use change to forest, woodland, and wooded (for) and a reduction efficiency for upland areas. 4:1 for N; 2:1 for P/SS
Effectiveness Estimate	TN: 19–65% TP: 30–45% TSS: 40–60%
Credit Expiration	15 years and then it needs to be verified and re-entered
Total Annual Cost per Acre (Watershed-wide Avg.)	$99.53

Description

A forest buffer can be 35-300’ according to the Standard Practice of the Natural Resources Conservation Service Conservation Practice Standard (Practice 391). All of these buffers (with minimum 35’ width) receive the full efficiency in the CBWM. The average forest buffer width currently being restored in the Bay watershed is 101 feet (CBP unpublished).

Agriculture Narrow Buffer

Narrow Buffer Strips (between 10- 35' wide) are a distinct practice, separate from riparian forest and riparian grass buffers of 35' and greater. These strips receive the benefit of land-use change only—without the additional upland benefits provided a regular buffer. (Phase 5.3. of the model allows this practice but labels it as a land retirement or tree planting practice.) Narrow forest buffer are linear strips of wooded areas maintained on agricultural land between the edge of fields and streams, rivers or tidal waters that are less than 35' wide and help filter nutrients, sediment and other pollutants from runoff.

Progress and Opportunity

States can build agricultural buffers on land adjacent to streams and rivers, commonly these land uses are crop, mixed open and pasture. States should conserve natural buffers (i.e., forests and wetlands) because only a net gain in buffers can be reported.

The sensitive and limited riparian area should receive careful consideration and planning.
Partners have a better idea than ever what is the universe of riparian area that could be restored. Collectively, Bay state WIP IIs, promised more acres of buffer restoration than was available (i.e., higher than an E3 scenario). Below, the "State Tree Cover and Buffer Land Use" document provides the breakdown of herbaceous agricultural land where counties can plant Forest Buffers.

Example: Land Use in 30m Buffer Zone in West Virginia Counties

County Name	Total Area 30m	Crop	Mixed Open	Pasture	Natural 30m (Ac)
Hardy	46944	1271	1183	5431	33878
Jefferson	15453	1962	1149	2489	5595
Mineral	24805	746	373	4083	16552

E3 Potential

The E3 Scenarios in CAST shows how much opportunity for Forest Buffer development exists in any county. See example below of rorest buffer opportunity in Delaware.

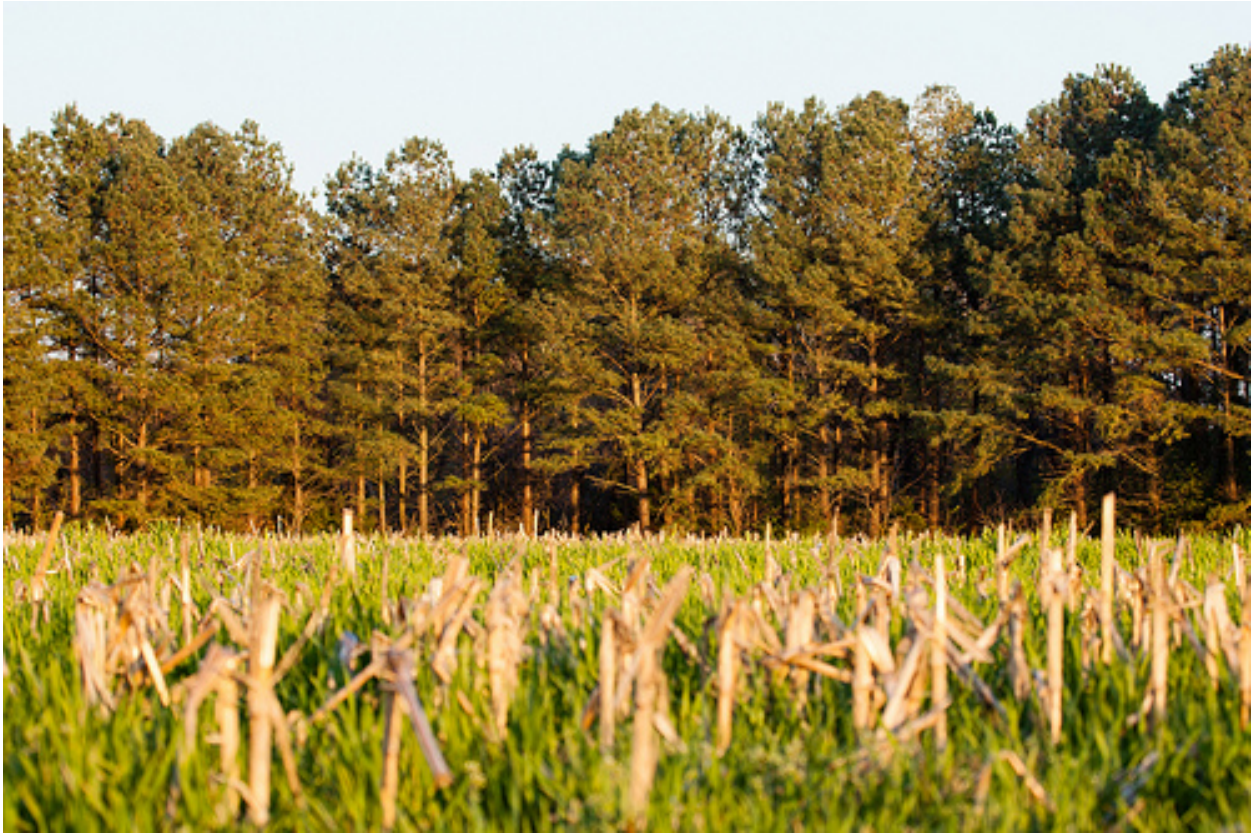
County Name	Buffer Acres (2013)	Buffer Acres (E3)	Opportunity (ac)
Kent	402	6038	5636
New Castle	44	2141	2097
Sussex	902	9328	8426

Tree Planting (Ag)

Agricultural Tree Planting	
Definition:	Tree planting includes any tree planting, except those used to establish riparian forest buffers, targeting lands that are highly erodible or identified as critical resource areas.
Efficiency Credited	Land use change to forest
Effectiveness Estimate	N/A
Credit Expiration	10 years and then it is picked up as Land Use
Total Annual Cost per Acre (Watershed-wide Avg.)	$70.72

Description

Agricultural tree planting includes any tree planting on agricultural land, except those used to establish riparian buffers. Lands that are highly erodible or identified as critical resource areas are good targets for tree planting.



Progress and Opportunity

Tree Planting BMP Acres Reported 1990-2013

State	1990	1995	2000	2005	2010	2013
DE	4.9	10.7	10.8	12.1	139.3	1036.1
MD	36.5	176.6	327	667.8	891.8	686.7
PA	0	0	0	0	2285.7	2289.1
VA	3755	6212	4901.4	2459.7	13806.4	18909.1
WV	0	0	0	0	464.6	1057.3

States should work with landowners to identify areas of agricultural land that can most benefit from tree planting. Erodible lands can help save money for farmers and improve water quality.

Forest Harvest BMPs

Forest Harvest BMPs

Forest Harvest BMPs	
Definition:	Forest harvesting BMPs are a suite of BMPs that minimize the environmental impacts of road building, log removal, site preparation and forest management. These practices help reduce suspended sediments and associated nutrients that can result from forest operations.
Efficiency Credited	Land Use Change to for
Effectiveness Estimate	TN: 50% TP: 60% TSS: 60%
Credit Expiration	3 years and then land use reverts to forest from Harvested Forest
Total Annual Cost per Acre (Watershed-wide Avg.)	$64.01

Description

Forest harvesting practices are a suite of BMPs that minimize the environmental impacts of logging, including road building and site preparation. These practices can greatly reduce the suspended sediments and other pollutants that can enter waterways as a result of timber operations (see above for credit). The CB model currently assumes an average of 1% of forest is harvested in any given year, unless more accurate data are supplied by the state. The modeled pollution load from forest harvesting is reduced based on the annual number of acres of forest harvesting BMPs reported.

Progress and Opportunity

Reporting of Forest Harvest BMPs has been sporadic, with many states not reporting their acreage. States should attempt to report their BMP progress so that it is credited in CAST.

Forest Harvest BMP Acres Reported 1990-2013

State	1990	1995	2000	2005	2010	2013
DE	0	1414.4	1412.9	1407.2	1395.1	1201.8
VA	0	70931.2	89496.7	100099.6	115929.6	124209.3
WV	0	17090.8	18697.5	17329.7	11982.6	16116.2

Most states assume a certain rate of forest harvest BMP implementation because data are not always available on forest harvesting on private land.

State	Total Forest (Ac)	Estimated Acres Harvested (Annual)	BMP Implementation Rate
MD	2124760	21247	88%
DE	92767	927	93%
VA	8691940	86919*	96.8%*
PA	8408841	84088	N/A
WV	1655944	16559	N/A
NY	2291597	22915	N/A

*Virginia reports actual acres of forest harvest and forest harvest BMPs.

Forest Conservation BMP (Maryland only)

Description

The forest conservation BMP applies only to Maryland at this time. It is not merely the protection of forests. This BMP exists because of the Maryland Forest Conservation Act that requires developers to maintain at least 20% of a development site in trees (forest condition). This is actually a preventative type of BMP which alters the rate of urban conversion. The acreage is calculated from the annual urban increase (population based).

The 20% is specific to the Maryland Act and could be different for each jurisdiction or various locations within a jurisdiction.

Regulatory Framework

The Forest Conservation BMP requires a regulatory framework such as Maryland's Forest Conservation Act. If certain localities in a state have sufficient regulatory frameworks, they can receive credits for their actions under this BMP. Please refer to () to determine whether a certain regulatory framework is sufficient for credit.

BMP Cost Information

Average Forestry BMP Costs

BMP Name	Total Annualized Cost per Acre
Forest Buffer (Urban)	$86.17
Urban Tree Canopy Expansion	$66.75
Urban Forest Planting	$82.57
Forest Buffer (Agriculture)	$99.53
Tree Planting (Agriculture)	$70.72
Forest Harvesting Practices	$64.01
Forest Conservation	$0

The CAST model gives states the opportunity to assess the costs per unit of each specific BMP. Cost information in CAST varies by state. This information was gathered by the CBP and cross-checked with state representatives. In the model, **costs can be altered if a value is assessed to be inaccurate**. To access their own state cost profile, states should downloads reports from the "Cost Profile" tab on the CAST website.

For example, in Delaware, the Total Annualized Cost per Acre of all forest-related BMPs is below:

BMP Name	Total Annualized Cost per Acre
Forest Buffer (urban)	$26.81
Urban Tree Canopy Expansion	$11.75
Urban Forest Planting	$133.58
Forest Buffer (agriculture)	$28.90
Tree Planting (agriculture)	$19.25
Forest Harvesting Practices	$64.01

On agricultural land, the riparian forest buffer BMP has a higher cost when placed in pasture since exclusion fencing is necessary. Also, state costs vary because of the way the practice is implemented and the opportunity costs.

Optimization

Optimization tools are currently in progress for the CAST software. States should use their existing information about pounds of nutrients reduced per acre of forest BMPs to calculate the most cost-effective BMP in their state.

Reporting and Verification

All BMP information submitted to the Chesapeake Bay Program Office must be compatible with National Environmental Information Exchange Network (NEIEN) protocols. See more information at the TMDL Tracking page on the CAST website.

Reporting Contacts

The state contacts for tracking and reporting nonpoint source BMPs are as follows:

Jurisdiction	Name	Office	Email	Phone
New York	Sara Latessa	NY DEQ	sara.latessa@dec.ny.gov	518-402-8279
Pennsylvania	Ted Tesler	PA DEP	thtesler@state.pa.us	717-772-5621
Maryland	Greg Sandi	MDE	gregorio.sandi@maryland.gov	410-537-3742
Delaware	Marcia Fox	DNREC	marcia.fox@state.de.us	302-739-9922
District of Columbia	Martin Hurd	DOEE	martin.hurd@dc.gov	202-299-3344
Virginia	Bill Keeling	VA DEQ	william.keeling@deq.virginia.gov	804-698-4342
West Virginia	Alana Hartman	WV DEP	alana.c.hartman@wv.gov	304-993-6814

Verification Guidelines

The Forestry Workgroup developed Verification Guidance for the Bay Program partners. State forestry BMP verification protocols were developed from the Guidance and excerpts of these were shared with the Forestry Workgroup. This document was pulled together to heighten awareness of what level of verification states are requiring. All BMPs reported in 2018 are expected to be verified.

References

Expert Panel Report on Agricultural Buffers

Expert Panel Report on Tree Canopy Expansion and Urban Forest Planting

CAST Source Data

EPA's Phase III WIP Expectations

BMP Tracking and Reporting Leads