Silvicultural Best Management Practices Implementation Monitoring for Virginia

2020

Introduction

The Virginia Department of Forestry Best Management Practices Implementation Audit Program is based primarily on the Southern Group of State Foresters published framework for state forestry agencies (http://www.southernforests.org/publications/SGSF%20Regional%20BMP%20Framework%20Protocol%20publication_2007.pdf/view). This standardized protocol was intended to ensure that data collected by southern states could be combined into one report. That report is periodically compiled, prepared and submitted to the USDA Forest Service Region 8, as well as USEPA in Atlanta by the Southern Group of State Foresters. However, this protocol is sufficiently flexible to be applied to each state's individual BMP guidelines. At the direction of the State Forester, Virginia is monitoring 240 harvested tracts each year and compiling an independent annual report based on this protocol. These data are submitted periodically for the Southern Group five-year report (http://www.southernforests.org/publications).

Methods

Every quarter of every year, 60 tracts are selected randomly from harvests that received a VDOF final inspection two quarters previous to the audit quarter. This allows approximately three to six months between BMP implementation and the audit field visit. This timing allows for an assessment of how BMP integrity changes over time and provides for a modest sampling of silvicultural practices, such as site preparation, tree planting and weed control. VDOF is randomizing within each of the three administrative regions (Eastern, Central and Western) with the number of selected tracts proportional to the number of harvests for each sample quarter. This concentrates BMP audits in areas where most harvesting is occurring. In this, the 13th audit cycle (1st – 4th quarter, 2020), there are 240 total audits completed and the regional breakdown is displayed in Table 1.

Table 1. Number of BMP audits completed by VDOF administrative region during the audit cycle for the 2020 calendar year.

Region	Number of Audits
Central	106
Eastern	82
Western	52

Each audit tract will result in a "% Yes" score for each BMP category. That percentage describes what proportion of audit questions in that category that were applicable to that tract were positively fulfilled by the operator in the field. The audit questions are evaluated and answered during a field visit by one of three water quality engineers and/or 10 water quality specialists who are full-time VDOF personnel. Every auditor is regularly trained in a group setting to maintain accuracy and consistency across the state. This enables VDOF to evaluate audit results generally by BMP category or type.

Each of the 240 tracts audited is treated as a discreet unit, and the average and median tract scores are reported as the "harvest average or median score." Each audit is comprised of 117 questions in 10 categories (Appendix A). These data are also combined across all tracts, and all question responses are averaged together as a single data set by audit category and reported as the "BMP average." This is the average percentage of "Yes" responses when all audit questions are considered together without regard for the individual tract audits. This approach attempts to more accurately describe the overall BMP condition as a whole in Virginia. This BMP average also assigns greater importance to audits that have more applicable questions. These data consist of 28,080 total questions of which 19,075 were deemed not applicable, 661 were answered "No" and 8,344 were answered "Yes." These categories and questions relate directly to the major recommendations outlined in the BMP manual entitled *Virginia's Forestry Best Management Practices for Water Quality, 5th Edition*. This technical manual is available online

(http://www.dof.virginia.gov/infopubs/BMP-Technical-Guide_pub.pdf). In most cases, a large portion of the questions may not apply to any specific tract. Questions or entire categories that do not apply to a tract are given a non-applicable (N/A) status and are not included for calculation of final results. This ensures that calculated averages do not reflect missing items that do not apply to the harvest.

Each individual question in the audit process is also tracked over time to determine which BMP issues in the BMP Manual are in need of improvement. This information is particularly valuable to the SHARP Logger program, which is an SFI industry-sponsored logger training program at Virginia Tech (http://sharplogger.vt.edu/) as it can help guide future educational efforts. These data also will assist VDOF, industry and consulting personnel as they inspect tracts and assist operators on the ground.

Results

The data for the 2020 audit are displayed as a series of tables and charts. Table 2 displays overall BMP average data for the entire state by BMP category. Confidence in the data is reported as a 95 percent margin of error and was calculated according to the SGSF protocol and generally accepted statistical procedures.

While Table 2 shows statewide results, Table 3 shows the BMP average values by VDOF administrative region. These averages (Tables 2 and 3) are the result of combining questions in the categories across all 240 audits as a single complete set and averaging those questions by category. This is the best method to evaluate overall BMP issues across the state. It is important to note that when all individual harvest audit scores were simply averaged together (harvest average) the value calculated is slightly different and, in this case, is approximately 92.7 percent statewide. The averages in Tables 2 and 3 address the overall BMP condition as indicated by all audits combined while the average value of the tract audits (92.7 percent) ignores the fact that not all audits are the same with regard to number of pertinent issues (non-N/A questions) involved and assumes all audits are of the same weight. Both values are useful and correct as long as the user understands the difference as stated above and in the previous "Methods" section.

These data indicate that very little site preparation (fire and chemical) is taking place up to six months after harvest, and it is for this reason that caution should be used when considering the importance or value of the site preparation averages. Less

Table 2. Statewide data for the BMP audit by BMP category. These data represent statewide averages for Virginia for the 2020 audit cycle.

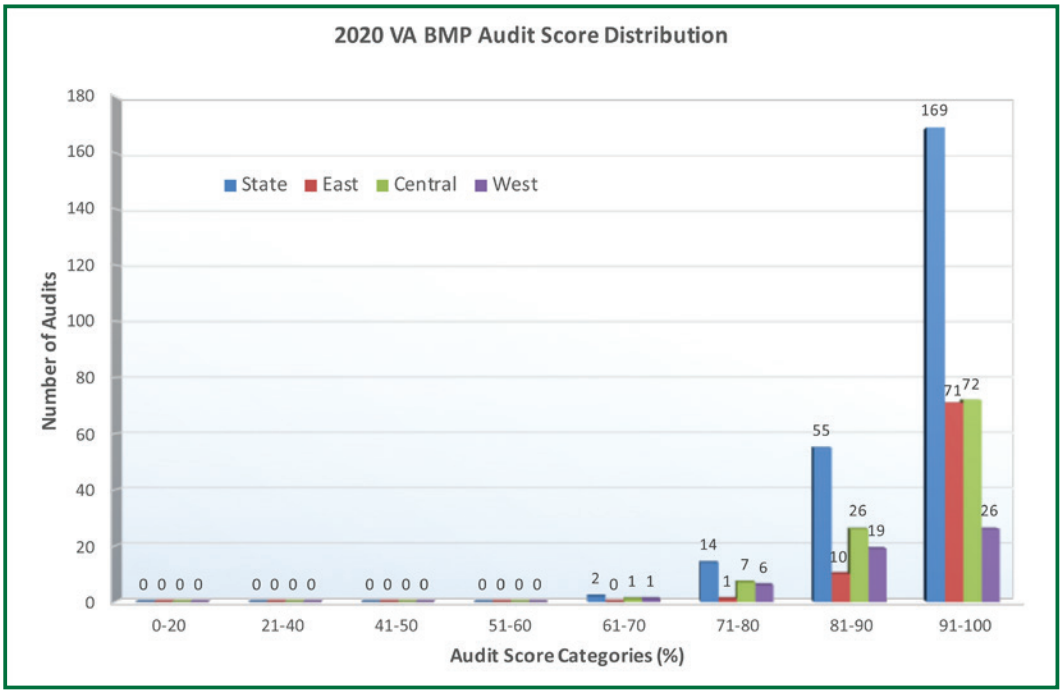
BMP Category	Number of Tracts	Yes (%)	Margin of Error (%)
Chemicals	8	100.0	+/- 0
Crossings	107	95.5	+/- 4
Decks	239	96.6	+/- 2.4
Fire	3	90.0	+/- 34.6
Mechanical Site Prep	2	92.9	+/- 36.4
Planning	239	94.7	+/- 2.9
Roads	193	89.9	+/- 4.3
Skidding	238	90.1	+/- 3.9
SMZs	181	93.1	+/- 3.8
Wetlands	9	90.2	+/- 19.8
All	240	92.7	+/- 3.4
Logging	240	92.7	+/- 3.4

Table 3. Regional data for the BMP audit by BMP category. These data represent regional averages for all three regions for the 2020 audit cycle.

BMP Category	Central (% Yes)	Eastern (% Yes)	Western (% Yes)
Chemicals	100.0	100.0	100.0
Crossings	96.9	97.3	91.0
Decks	96.5	97.5	95.4
Fire	90.0	N/A	N/A
Mechanical Site Prep	92.9	N/A	N/A
Planning	96.6	98.5	86.2
Roads	87.8	94.6	89.3
Skidding	88.8	98.0	85.4
SMZs	93.8	96.1	87.5
Wetlands	93.3	88.9	N/A
All	92.4	96.7	89.2

than half of all audit tracts (107 of 240) had at least one stream or wetland crossing. It is apparent that three very important categories that often lead to water quality concerns, roads, crossings and skid trails, sometimes lag behind other categories with regard to implementation percentage (Tables 2 and 3) – two of these three categories are slightly higher from the previous year.

Figure 1: A histogram describing the score distribution of all 240 audits for the 2020 audit cycle in Virginia.



The histogram (Figure 1) indicates that the vast majority of tracts scored an overall implementation percentage of 81 percent or greater. While the overall mean BMP implementation for all tracts is 92.7 percent (Table 2) and the overall harvest average score is 92.78 percent, the harvest median score is 95.0 percent. Given the skewed distribution of the overall scores in Figure 1, the median is perhaps a better judge of central tendency of the tract score data. These results indicate a steady level of BMP implementation statewide over recent years, and it should be understood that random sample averages fluctuate over time and small year to year changes may not indicate a real change in BMP implementation. Any real changes will become apparent over the long term as more data are accumulated.

This audit report includes the expectation that all BMPs should be done per the manual regardless of likely impacts on water quality on each harvested tract. In most cases, BMPs that are not done do not directly impact water quality. These BMPs can be considered "luxury" BMPs as they are recommended by the manual but are not necessarily impacting water quality. Any BMP failures on the part of the operator that directly impact water quality are apparent in the significant risk and active sedimentation tallies as reported in Table 4 and the explanation below. These singular failures are also handled through the VDOF silvicultural water quality law enforcement process according to § 10.1-1181.2 (http://law.lis.virginia.gov/vacode/title10.1/chapter11/section10.1-1181.2/).

The definition of significant risk describes a water quality concern that is observed on an audit tract that, due to a lack of BMPs, is causing or is likely to cause pollution. When a significant risk was noted during an audit field visit, the auditor also determined if active sedimentation was occurring. Audits that indicated a significant risk were isolated and evaluated independently of all other audits. Out of the 240 tracts in this audit cycle, two (0.83 percent) had at least one significant risk, and one of those tracts (0.42 percent) had an active sedimentation concern. Table 4 summarizes the specific problems that were noted on the two tracts.

A second analysis including only tracts with at least one significant risk issue determined that the average "% Yes" score for those two harvests was 81.5 percent, the median harvest score was 82.5 percent and the average harvest score was 82.5 percent, which indicates that long-term water quality problems tend to persist on tracts where overall BMP implementation is well below the average and median values for all tracts.

The 86 audit tracts that were located in the Chesapeake Bay watershed were isolated and averages were calculated. The Bay harvest average score was 93.1 percent, and the tract median score was 95.5 percent while the BMP average of all the audit questions combined for all the Bay tracts was 92.2 percent. This is slightly better than the state as a whole. The Bay data also indicate that there were two tracts with significant risk issues, and one tract with active sedimentation was observed.

Table 4 indicates that operations that disturb or expose soil near to streams are more likely to cause a significant sedimentation risk if not properly stabilized. A combination of improper road and skid trail stabilization and unstable stream crossing approaches combine to include a large number of risks. Nearly all risks are related directly to unstabilized, exposed soil near a waterway. Simply avoiding most operations in or near to riparian areas would likely reduce risks to water quality. Minimizing roads, decks and stream crossings would clearly be beneficial to water quality risk reduction and would also reduce the number of BMP issues that need attention during and after the operation. Specific BMP deficiencies that almost always contribute to sedimentation issues deal specifically with a lack of drainage and stabilization of roads particularly on or near to stream crossings approaches. It is critical that operators use dips, bars and turnouts to guide water off of roads and clean gravel on slopes and approaches near waterways.

Table 4: Tally and description of significant risks to water quality and associated active sedimentation for the 2020 BMP audit cycle.

BMP Issue by Region and Type	Risk	Sediment
Central Region	**0**	**0**
Eastern Region	**1**	**1**
Crossings	**1**	**1**
Are approaches stable and unlikely to contribute to sediment to the stream?	1	1
Western Region	**1**	**0**
Skidding	**1**	**0**
Are all skid trails located outside the SMZ?	1	0
Statewide Total	**2**	**1**

Appendix A: Individual Audit Questions and Scores

Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
Chemicals	**931**	–	29	**960**	100.0
Did applicators avoid mixing chemicals or filling equipment where runoff would likely enter a stream?	233	–	7	240	100.0
Did applicators remove all refuse from the tract?	232	–	8	240	100.0
Did chemical applicators avoid accidental drift into sensitive areas or SMZs?	233	–	7	240	100.0
Did chemical applicators avoid applying chemical directly into streams or SMZs?	233	–	7	240	100.0
Crossings	**3,701**	**39**	**820**	**4,560**	**95.5**
Are approaches stable and unlikely to contribute sediment to the stream?	137	5	98	240	95.1
Are culvert pipes installed properly in the channel to avoid undercutting and channel erosion?	207	2	31	240	93.9
Are culverts and bridges of adequate length?	158	5	77	240	93.9
Are culverts covered with adequate and appropriate fill material?	207	1	32	240	97.0
Are culverts covered with gravel to reduce erosion near the stream?	208	5	27	240	84.4
Are culverts properly sized according to the BMP manual Tables 6 and 7 or Talbot's formula?	208	4	28	240	87.5
Are fords used only where a natural rock base (or geoweb) and gentle approaches allow?	237	–	3	240	100.0
Are head walls stabilized with vegetation, rock or fabric to minimize cutting?	210	2	28	240	93.3
Are permanent bridge abutments adequate and stable?	232	–	8	240	100.0
Are stream banks and approaches re-claimed with sufficient vegetation, rock or slash?	141	3	96	240	97.0
Are stream crossings installed at or near to right angles where possible?	133	1	106	240	99.1
Are stream crossings minimized?	133	3	104	240	97.2
Are temporary culverts, pole bridges and bridges removed?	159	1	80	240	98.8
Are water diversion structures present when needed on approaches?	156	7	77	240	91.7
Do all ford crossings avoid restricting the natural flow of water?	237	–	3	240	100.0
Do all ford crossings have a 50-foot approach of clean gravel?	237	–	3	240	100.0
Do all ford crossings have underlying geo-textile where needed (on approaches)?	239	–	1	240	100.0

Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
Is the addition of unnatural materials in the stream to facilitate the use of a ford minimized?	237	–	3	240	100.0
Were pole bridges used only in appropriate circumstances?	225	–	15	240	100.0
Decks	**451**	**59**	**1,650**	**2,160**	**96.5**
Are all decks limited in size?	1	2	237	240	99.2
Are all log decks located at least 50 feet from the nearest SMZ.	38	6	196	240	97.0
Are appropriate soil protection measures in place to prevent erosion on the deck?	15	19	206	240	91.6
Are decks reshaped where needed to ensure drainage?	87	3	150	240	98.0
Are fluid spills from equipment minimal?	2	6	232	240	97.5
Are log decks located on relatively well-drained ground with low to moderate slopes?	1	3	236	240	98.7
Are sediment trapping structures present if needed to prevent pollution?	156	–	84	240	100.0
Are water diversion structures installed to prevent water from crossing the deck?	150	10	80	240	88.9
Is the deck free of trash, garbage and other non-slash debris related to the harvest operation?	1	10	229	240	95.8
Fires	**3,560**	**4**	**36**	**3,600**	**90.0**
Are command and staging areas located away from streams?	237	–	3	240	100.0
Are large areas of bare soil re-vegetated where slope exceeded 5%?	238	–	2	240	100.0
Are water bars installed properly on firelines, roads and cleared areas?	237	–	3	240	100.0
Did fire crew avoid plowing up and down slopes where possible?	238	–	2	240	100.0
Did fireline construction avoid disturbing existing gullies?	238	–	2	240	100.0
Did the burning crew avoid exposing large areas of mineral soil?	237	–	3	240	100.0
Did the burning crew avoid pushing firelines directly into streams?	237	–	3	240	100.0
Does fireline construction follow appropriate skid trail BMPs?	237	2	1	240	33.3
Does fireline construction divert water away from streams where necessary?	237	–	3	240	100.0
Is all fire-related debris removed from stream channels?	237	–	3	240	100.0
Is all refuse and sewage disposed of properly?	237	–	3	240	100.0
Is vegetation or slash on firelines and cleared areas to prevent erosion as needed?	237	2	1	240	33.3
Were high intensity site-prep burns kept out of the SMZs?	237	–	3	240	100.0

Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
Were prescribed burns on fragile soils and steep slopes absolutely necessary to achieve goals?	238	–	2	240	100.0
Were steep grades and/or fragile soils protected from excessive burn and ground disturbance?	238	–	2	240	100.0
Mechanical_SP	**3,346**	**1**	**13**	**3,360**	**92.9**
Are SMZs maintained with no significant disturbance?	239	–	1	240	100.0
Did all mechanical operations avoid slopes in excess of 45%?	238	–	2	240	100.0
Did all mechanical operations avoid wet or fragile ground?	238	–	2	240	100.0
Did all mechanical operations take place on the contour to the extent possible?	238	–	2	240	100.0
Did bedding contractor avoid tying beds into streams, ditches or drainage structures?	240	–	–	240	N/A
Did machine planters avoid excessive slopes?	240	–	–	240	N/A
Did operators prevent debris or soil in the stream sufficient to degrade banks or impede flow?	239	–	1	240	100.0
Did raking, piling and windrowing avoid excessive movement or exposure of mineral soil?	238	1	1	240	50.0
Did scalping, furrowing and sub-soiling avoid connections to drainages?	239	–	1	240	100.0
Is scalping and furrowing less than 6 inches deep and on the contour?	240	–	–	240	N/A
Is soil disturbance minimized across the site relative to establishment goals?	238	–	2	240	100.0
Was bedding conducted on the contour where possible?	240	–	–	240	N/A
Was machine planting done on the contour?	240	–	–	240	N/A
Was sub-soiling or ripping done on the contour?	239	–	1	240	100.0
Planning	**151**	**30**	**539**	**720**	**94.7**
In the case of severe site conditions (very wet or steep) was the harvesting system modified to reduce damage to soil, site and water?	149	5	86	240	94.5
Is there evidence or knowledge of a harvest plan (painted lines, flagging, delineated hazards, SMZs or decks, engineered roads, etc…)?	1	24	215	240	90.0
Is there evidence that the logger utilized a harvesting system that is generally appropriate for the site and timber conditions?	1	1	238	240	99.6

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Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
Roads	**2,335**	**225**	**2,000**	**4,560**	**89.9**
Are grades between 2% and 10% except for necessary deviations?	57	3	180	240	98.4
Are new roads located and constructed to allow for proper drainage?	149	4	87	240	95.6
Are new roads located to avoid erodible, wet and sensitive ground?	151	1	88	240	98.9
Are riprap and/or brush dams used where needed to slow water and trap sediment?	188	5	47	240	90.4
Are roads built outside of SMZs where possible?	112	2	126	240	98.4
Are roads daylighted where needed and feasible?	58	4	178	240	97.8
Are roads in SMZs as far from the channel as possible and built to prevent stream sedimentation?	191	1	48	240	98.0
Are roads on the contour where practical?	64	2	174	240	98.9
Are roads outsloped where needed and conditions allow?	94	18	128	240	87.7
Are temporary roads retired with properly constructed water bars or tank traps?	201	5	34	240	87.2
Are turnouts directing water and/or sediment away from riparian areas?	161	2	77	240	97.5
Are under-road culverts installed, spaced and maintained properly?	207	2	31	240	93.9
Is access being controlled with a functional gate or barrier?	57	71	112	240	61.2
Is construction of dips, bars, turnouts and traps adequate to maintain function?	140	9	91	240	91.0
Is gravel or vegetation present to protect water bars from erosion?	126	22	92	240	80.7
Is there rock or vegetation on slopes where needed to prevent erosion?	87	27	126	240	82.4
Is water being "turned out" into surrounding landscape with appropriate structures?	107	16	117	240	88.0
Is water diverted from the road surface at specified intervals using dips, bars or traps?	126	30	84	240	73.7
Was road construction and use minimized?	59	1	180	240	99.4
Skidding	**1,224**	**187**	**1,709**	**3,120**	**90.1**
Are all skid trails free from channelized flow that is likely to cause sedimentation?	4	5	231	240	97.9
Are all skid trails located outside the SMZ?	44	8	188	240	95.9
Are appropriate cross drainages installed where springs or seeps crossed the trails?	212	1	27	240	96.4
Are bladed skid trails limited to less than 26% grade unless absolutely necessary?	168	1	71	240	98.6

Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
Are bladed skid trails limited to side slopes less than 60%?	171	–	69	240	100.0
Are un-bladed trails limited to side slopes less than 36% in general?	87	–	153	240	100.0
Are water bars established on trails where erosion is likely at recommended intervals?	127	45	68	240	60.2
Are water turnouts built to ensure drainage of skid trails where needed?	147	16	77	240	82.8
Did the logger avoid skidding logs through intermittent or perennial streams?	57	1	182	240	99.5
Do trails avoid long, continuous grades?	37	12	191	240	94.1
Do trails avoid rutting that will likely cause channelized erosion near a stream?	25	2	213	240	99.1
Is vegetation established where needed on trails to prevent erosion and sedimentation?	100	64	76	240	54.3
Were brush mats used to stabilize trails and prevent erosion where needed?	45	32	163	240	83.6
SMZs	**1,507**	**111**	**1,502**	**3,120**	**93.1**
Are all SMZs a minimum of 50 feet wide on each side of the stream bank?	61	36	143	240	79.9
Are SMZ widths modified to accommodate cold water fisheries and municipal water supplies?	238	–	2	240	100.0
Did the logger avoid exposing large sections of soil in the SMZ?	66	3	171	240	98.3
Did the logger avoid partial or patch clear cutting in the SMZ?	59	18	163	240	90.1
Did the logger avoid silvicultural debris in the stream that would warrant a law enforcement action under the "debris in the stream law?"	91	–	149	240	100.0
Did the logger avoid silvicultural sediment in the stream that might endanger public health, beneficial uses or aquatic life as stated in the "silvicultural water quality law?"	77	–	163	240	100.0
Do all intermittent and perennial streams have an SMZ?	72	10	158	240	94.0
Do all sinkholes or karst features have an SMZ?	234	1	5	240	83.3
Does at least 50% of the original basal area exist in the SMZ?	60	29	151	240	83.9
In tidal areas, has a 50-foot SMZ been maintained from the grass or marsh edge?	237	–	3	240	100.0
Is SMZ width relatively consistent along the entire length?	60	11	169	240	93.9
Is the SMZ free of roads and landings where possible?	66	2	172	240	98.9
Was exposed soil in the SMZ re-vegetated or covered with organic materials?	186	1	53	240	98.1

Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
Wetlands	**1,869**	**5**	**46**	**1,920**	**90.2**
Are landings located on appropriate ground?	232	1	7	240	87.5
Did operations in wetlands avoid altering hydrology of the site to such a degree as to convert a wetland to a non wetland?	231	–	9	240	100.0
Did the operation avoid activities during particularly wet weather?	231	2	7	240	77.8
Is water movement maintained on the site?	232	–	8	240	100.0
Was low ground pressure equipment (LGP) utilized where needed?	236	1	3	240	75.0
Was the harvesting system appropriate for the site conditions?	231	1	8	240	88.9
Were the 15 mandatory road BMPs followed for wetland roads?	237	–	3	240	100.0
Were the six mandatory site-prep BMPs followed as needed?	239	–	1	240	100.0
Grand Total	**19,075**	**661**	**8,344**	**28,080**	**92.7**

Acknowledgements

Virginia Department of Forestry

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