Assessment of Penn State University Survey of Farms in Pennsylvania

December 9, 2016

Prepared for
U.S. Environmental Protection Agency, Chesapeake Bay Program Office
and
Pennsylvania Department of Environmental Protection

Prepared by
Tetra Tech, Inc.

Assessment of Penn State University Survey of Farms in Pennsylvania

Summary

Tetra Tech (Tt) performed a review of the Penn State University (PSU) survey of farms in Pennsylvania to guide decisions regarding the survey's suitability to generate best management practice (BMP) implementation data that could be reported to the Chesapeake Bay Program (CBP) and credited in the Bay Model. Tt completed a draft assessment of the survey based on briefing materials, a methodology report, and communications with Matt Royer, principal investigator for PSU. The draft assessment is found here as Attachment 1 and included recommendations to (1) determine county-to-county variability of method accuracy and (2) address under- or over-reporting to ensure the most accurate county-level reporting for credit in the Bay model.

PSU then delivered the following report on November 18, 2016:

> Royer, M., J. Shortle, and A. Cook. 2016. *An Analysis of the Pennsylvania Farm Conservation Practices Inventory for Purposes of Reporting Practices to the Chesapeake Bay Program- Preliminary Draft for Discussion November 18, 2016*. Agriculture and Environment Center Environment and Natural Resources Institute, Penn State University. Prepared for the Pennsylvania Department of Environmental Protection.

Review comments on this report were provided by Tt in a Technical Memorandum dated November 21, 2016 and found here as Attachment 2. In this review Tt recommended that PSU (1) show how it performed the calculations to adjust riparian buffer acres, (2) include data tables to accompany Figures 5-13, and document adjustment factors for over- and under-reporting in a table in the report.

PSU then delivered the following revised report on December 1, 2016:

> Royer, M., J. Shortle, and A. Cook. 2016. *An Analysis of the Pennsylvania Farm Conservation Practices Inventory for Purposes of Reporting Practices to the Chesapeake Bay Program- Revised Draft for Discussion and Decision at December 15, 2016 Chesapeake Bay Program Ag Workgroup Meeting December 1, 2016*. Agriculture and Environment Center Environment and Natural Resources Institute, Penn State University. Prepared for the Pennsylvania Department of Environmental Protection.

Review comments on this report were provided by Tt in a Technical Memorandum dated December 6, 2016 and found here as Attachment 3. In this review Tt recommended that PSU explain the calculation of the mean and confidence intervals for BMP extent in greater detail to benefit those applying the method in the future. Tt also provided an example that could be incorporated in an appendix to the report.

PSU delivered the following draft final report on December 6, 2016:

Royer, M., J. Shortle, and A. Cook. 2016. *An Analysis of the Pennsylvania Farm Conservation Practices Inventory for Purposes of Reporting Practices to the Chesapeake Bay Program- Revised Draft for Discussion and Decision at December 15, 2016 Chesapeake Bay Program Ag Workgroup Meeting December 6, 2016*. Agriculture and Environment Center Environment and Natural Resources Institute, Penn State University. Prepared for the Pennsylvania Department of Environmental Protection.

Tt reviewed this draft and concurred with Matt Royer via email (December 7, 2016) that the report was now "ready to be shared with the Ag Workgroup for their consideration and decision on Dec 15."

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DRAFT

November 15, 2016

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Executive Summary

An assessment of the Penn State University (PSU) survey of farms in Pennsylvania was performed to guide decisions regarding the survey's suitability to generate best management practice (BMP) implementation data that could be reported to the Chesapeake Bay Program (CBP) and credited in the Bay Model. The assessment consisted of three components: the degree to which practices tracked in the survey match BMPs used in the Bay Model, the degree to which methods used in the survey met CBP verification requirements, and the accuracy of the survey method as measured with field verification data.

The PSU survey included practices that can be matched with BMPs and resource improvement practices (RIs) used in the Bay Model. Field verification methods addressed both practices that adhered to U.S. Department of Agriculture (USDA) or state design specifications for BMPs and those that were verified with visual indicators (VIs) for RIs. Training and staff expertise satisfied CBP verification guidance requirements.

The survey was designed as an alternative to the CBP requirement that 100 percent initial verification is required of most practices. One exception to the full initial verification requirement allows for single-year BMPs to be statistically sub-sampled. Analyses by both PSU and Tt demonstrate that the PSU survey method is largely accurate for most practices included in the PSU survey. This accuracy, however, is based on the aggregate sample. Tt recommends additional analysis to determine county-to-county variability of accuracy. Further, under- or over-reporting can and should be addressed to ensure the most accurate county-level reporting for credit in the Bay model.

Introduction

Penn State University and the Pennsylvania Department of Environmental Protection (DEP) undertook a conservation practice inventory (survey) to capture data on visual and non-visual non-cost-share BMPs for reporting and crediting in the Bay model. Survey forms completed by participating farmers serve as a farm inventory as defined by the CBP verification guidance (*Strengthening Verification of Best Management Practices Implemented in the Chesapeake Bay Watershed: A Basinwide Framework*, October 2014). Specifically, the type of farm inventory used in this effort is a farmer self-certified inventory that trained and certified federal, state, or county personnel verify on-site.

DEP has requested that the Agriculture Workgroup accept an initial verification approach that extrapolates the findings from the 10% of farms verified on-site to the total number (6,782) of survey responses. This would apply to all potentially eligible visual and non-visual non-cost-share BMPs. Tetra Tech (Tt) was contracted to provide an independent analysis and assessment

of both the methods and results from this survey. The analysis performed by Tt consists of three related components: the degree to which the practices tracked for the pilot project translate directly to CBP BMPs, whether pilot project verification methods followed CBP verification requirements, and a statistical analysis to determine the accuracy of the method.

The following report includes a brief overview of the survey, followed by a discussion of the three analytic components. A summary at the end highlights the major observations.

Overview of Survey

The CBP verification guidance specifies requirements for both initial and follow-up verification of BMPs for credit in the Bay model. The goal for the PSU survey is to generate data on non-cost-shared annual and multi-year structural BMPs and plan implementation that will be accepted for initial verification of BMPs and credit in the Bay model (DEP 2016b). More specifically, DEP has requested that the following language be added to page 5 of the Agriculture BMP Verification Guidance (Appendix B to CBP verification guidance):

> *However, a jurisdiction may choose to utilize a self-certified assessment inventory for initial verification of non-cost shared annual and/or multi-year structural BMPs and plan implementation, with an on-site follow-up of 10% (or other valid statistical sample size, as appropriate) of the assessment respondents. Jurisdictions may report the extrapolated data to the total number of inventory responses.*

The survey methodology is described in briefing materials (DEP 2016b) and a methodology report (PSU 2016). In essence, farmers were sent conservation practices inventory forms to complete and submit to PSU. Approximately 10 percent of the responses from each county were then randomly selected for field verification by trained Extension agents. Results from farmer inventories were compared against field inventories to assess the accuracy of the method. Of an estimated 33,610 farms in Pennsylvania's portion of the Chesapeake Bay watershed, PSU sent inventories to approximately 20,000 farms. A total of 6,782 surveys were returned (34%) and approximately 10 percent of the responses (711 farms) were selected for on-site verification.

Crosswalk of Practices Tracked versus CBP BMPs

Practices included in the survey were:
- Nutrient management plans (acres by row crops, pasture, and hay)
    - Act 38 nutrient management plans (acres by row crops, pasture, and hay)
    - NRCS 590 nutrient management plans (acres by row crops, pasture, and hay)
    - Manure management plans (acres by row crops, pasture, and hay)
- Advanced nutrient management plans (acres by row crops, pasture, and hay)
- Manure transport (tons/galloons by manure type)
- Animal waste storage systems (number by dairy, beef, swine, and poultry)
- Barnyard runoff control systems (number)
- Agricultural erosion and sedimentation control plans (acres by row crops, pasture, hay, and barnyard)
- NRCS conservation plans (privately funded)

- No till or minimum till (acres)
- Cover crops (acres by species)
- Stream bank fencing (fencing length, distance to stream, acres of buffer)
  - Privately funded
  - Publicly funded
- Riparian buffers (acres, buffer width)
  - Privately funded
  - Publicly funded

A crosswalk between practices included in the PSU survey and BMPs and RIs that are potential matches is provided in Table 1. In its verification QAPP, DEP expressed the following intent regarding reporting of nutrient management implementation (DEP 2016a):

- *Manure Management Plans (MMPs). PA anticipates that these plans will be considered as Tier 1 by the CBP; and*
- *Nutrient Balance Sheets (NBSs). These are plans that are associated with Act 38 Nutrient Management Plans (NMPs) on agricultural operations that export manure to other operations or for other uses. NBSs can also be an alternative to MMPs for Tier 1. Pennsylvania will evaluate this option and update the QAPP before reporting any NBSs.*
- *Act 38 Nutrient Management Plans (NMPs), Concentrated Animal Feeding Operations*
- *(CAFO) plans, and NRCS Code 590 NMPs are to be considered as Tier 2 by the CBP; and Precision Nutrient Management and Planning (Precision NM). PA anticipates that*
- *Precision NM activities carried out in Pennsylvania will be considered as Tier 3.*

Note that the Phase 6 Nutrient Management Expert Panel has set forth an alternative set of nutrient management BMPs for the Phase 6 model that have not yet been approved. Because there is considerable overlap between approved Phase 5.3.2 nutrient management BMPs and proposed Phase 6.0 nutrient management BMPs, it is assumed here that a crosswalk for Phase 6.0 nutrient management would be similar to some degree.

Table 1. Crosswalk between PSU survey practices and CBP BMPs and RIs

PSU Survey Practices	CBP BMP	CBP RI Practice
Cover Crops	Cover Crops	
No Till or Minimum Till	Conservation Tillage, High Residue, Minimum Soil Disturbance Tillage	
Riparian Buffers in Trees or Shrubs	Forest Buffers	RI-9, 10: Forest Nutrient Exclusion Area or Buffer on Watercourse Resource Improvement Practice, Forest Nutrient Exclusion Area on Watercourse (RI9), Forest Buffer on Watercourse (RI10)
Riparian Buffers in Grass	Grass Buffers/Vegetated Open Channel - Agriculture, Vegetated Open Channels - A/B soils, no underdrain, Vegetated Open Channels - C/D soils, no underdrain	RI-7, 8: Grass Nutrient Exclusion Area or Buffer on Watercourse Resource Improvement Practice
Barnyard Runoff Control Systems	Barnyard Runoff Control	RI-16: Barnyard Clean Water Diversion
Agricultural Erosion and Sedimentation Control Plans NRCS Conservation Plans	Soil Conservation and Water Quality Plans	
Manure Transport	Manure Transport	
Nutrient Management Plans (acres by row crops, pasture, and hay) • Act 38 nutrient management plans (acres by row crops, pasture, and hay) • NRCS 590 nutrient management plans (acres by row crops, pasture, and hay) • Manure management plans (acres by row crops, pasture, and hay) Advanced Nutrient Management Plans	Nutrient Management (Phase 5.3.2 or Phase 6.0)	
Stream Bank Fencing	Stream Access Control with Fencing, Exclusion Fence with Forest or Grass Buffer or Narrow Buffer	RI-4a, 4b, 5, 6: Watercourse Access Control Resource Improvement Practice, (RI-4a) Watercourse Access Control-Narrow Grass, (RI-4b) Watercourse Access Control-Narrow Trees, (RI-5) Watercourse Access Control-Grass, (RI-6) Watercourse Access Control-Trees
Animal Waste Storage Systems	Waste Storage Facility, Waste Treatment, Animal Waste Management System	Dry Waste Storage Structure (RI-1)

Assessment of PSU Survey Methodology

The CBP has specified verification methods that can be used to confirm the presence and functionality of BMPs that are reported for credit in the Bay Model. The methods used for the PSU survey were compared with the procedures specified in the CBP verification guidance (*Strengthening Verification of Best Management Practices Implemented in the Chesapeake Bay Watershed: A Basinwide Framework*, October 2014). Appendix B of the verification guidance addresses agricultural BMPs and Appendix H has guidance for RI practices.

Agricultural BMP Verification Guidance

The Agriculture BMP Verification Guidance (Appendix B of CBP verification guidance) "recommends" that a jurisdiction verify 100% of the initial identification of non-cost-shared (privately funded) annual or multi-year structural BMPs and plans. Verification would be conducted by trained and certified technical field staff or engineers who would provide supporting documentation that the practice meets governmental and/or CBP practice standards. Visual assessment for single-year BMPs, such as tillage practices, can be statistically sub-sampled using scientifically accepted procedures. Non-cost-shared BMPs also include RIs.

Table 2 summarizes both the coverage and staff requirements for initial and follow-up verification of non-cost-shared BMPs. The focus of the PSU survey was on initial verification of BMPs. Non-cost-shared practices include both practices that fully meet NRCS practice standards and address CBP BMP definitions, and RIs which are non-cost shared practices that do not fully address all NRCS practice standards but do comply with appropriate CBP BMP definitions. Appendix H of the verification guidance provides specific VIs for verifying RIs. In all cases, initial verification of NRCS practices is to be performed by trained and certified technical agency field staff or engineers. However, any trained and/or certified technical field staff person that has the required knowledge and skills to determine if the practice meets the applicable RI definition and VIs may conduct the RI practice review.

Table 2. Initial and follow-up BMP verification coverage and expertise

BMP Implementation Mechanism	Initial Verification Method	Follow-Up Verification Method
Non-cost-shared	100% of the initial identification of annual or multi-year structural BMPs and plan implementation by trained and certified technical field staff or engineers with supporting documentation that it meets the governmental and/or CBP practice standards. Any trained and/or certified technical field staff person that has the required knowledge and skills to determine if the practice meets the applicable RI definition and VIs may conduct the review for non-cost-shared RIs. Visual assessment for single year BMPs, such as tillage practices, can be statistically sub-sampled utilizing scientifically accepted procedures.	(a) Default: random, follow-up assessments are recommended to be conducted on 10% of those multi-year BMPs which are known to collectively account for greater than 5% of a jurisdiction's agricultural sector nutrient and/or sediment load reductions as estimated in the most recent progress scenario (5% for lower priority BMPs) (b) Alternative strategy for follow up sub-sampling of non-cost shared BMPs.

A wide range of verification methods is described in the agricultural BMP verification guidance, including farm inventories, office or farm records, transect surveys, agency-sponsored surveys,

and remote sensing. The suitability of each of these methods for verification varies by BMP category (Visual Assessment BMPs - Single Year, Visual Assessment BMPs - Multi-Year, and Non-Visual Assessment BMPs), BMP implementation mechanism (Non-Cost-Shared BMPs, Cost-Shared BMPs, Regulatory Programs, and Permit-Issuing Programs), and specific aspect of BMP assessment (detection, meeting USDA/state design specifications, meeting federal/state operation and maintenance specifications, RI practice assessment, installation date, and expiration date), all of which is summarized in a series of tables in the verification guidance.

The verification guidance includes six options for farmer self-certified inventories as a means of reporting BMP implementation. These are described in detail in Appendix B of the verification guidance. The approach used by PSU is self-reporting with ten percent field verification by experts (Method 8). The applicability of Method 8 for various BMPs is summarized below.

Visual Assessment BMPs – Single Year: Method 8 is a Farm Inventory where "farmer completes a self-certified inventory survey and trained and certified federal, state and/or county personnel verify on-site." This is "Eligible" for Visual Assessment BMPs – Single Year, including with or without cost-share funds, and BMP with expired contracts. It is considered "Eligible" for BMP detection and practices that meet USDA/state design specifications and federal/state O&M specifications. It is also considered "Eligible" for installation and expiration dates. However, this method is considered "Non-Applicable" for RIs. The verification expectation is: "Annual frequency of inventories for all or sufficient statistical percentage of operations during BMP life span. Review of office/farm records."

Visual Assessment BMPs – Single Year include the following (those in italics were included in the PSU survey): *Conservation Tillage*; *High-Residue Minimum Soil Disturbance*; *Cover Crops*; Commodity Cover Crops / Interim BMPs-Dairy Manure Injection; *Annual No-till*; and Poultry Litter Injection. Because there are no RIs for tillage or cover crops, the "non-applicable" restriction pertaining to RIs has no effect on the practices included in the PSU survey.

Visual Assessment BMPs – Multi-Year: Method 8 is considered "Eligible" for all aspects of verification for these practices, including RIs. The verification expectation is: "Non-annual frequency of inventories for all or sufficient statistical percentage of operations during BMP life span. Review of office/farm records."

Visual Assessment BMPs – Multi-Year BMPs include the following (those in italics were included in the PSU survey): *Animal Waste Management Systems*; *Barnyard Runoff Control*; Bio-filters; *Continuous No-Till*; Forest Buffers; Grass Buffers; *Land Retirement*; *Stream-Side Forest Buffers*; *Stream-Side Grass Buffers*; Stream-Side Wetland Restoration; Tree Planting; Lagoon Covers; Loafing Lot Management; Mortality Composters; Non-Urban Stream Restoration: Shoreline Erosion Control; Off-Steam Watering w/o Fencing; *Stream Access Control with Fencing*; Prescribed Grazing; Precision Intensive Rotational Grazing; Horse Pasture Management; Pasture Alternate Watering Systems; *Soil Conservation & Water Quality Plan Elements*; Water Control Structures; Wetland Restoration / Interim BMPs- Alternative Crops; Dirt & Gravel Road Erosion & Sediment Control; Cropland Irrigation Management; Irrigation Water Capture Reuse; P-Sorbing Materials in Ag Ditches; and Vegetative Environmental Buffers- Poultry.

Non-Visual Assessment BMPs: Method 8 is considered "Eligible" for Non-Visual Assessment BMPs – Single Year, including with or without cost-share funds, and BMP with expired contracts. It is considered "Eligible" for BMP detection and practices that meet USDA/state design specifications. However, this method is considered "Potentially Eligible" for BMPs meeting federal/state O&M specifications, installation date, and expiration date. It is "Non-Applicable" for RIs. The verification expectation is: "Annual frequency of inventories for all or sufficient statistical percentage of operations during BMP life span. Review of office/farm records."

Non-Visual Assessment BMPs – Single Year include the following (those in italics were included in the PSU survey): Dairy Precision Feeding; Swine Phytase; *Poultry Litter Transport*; Poultry Litter Treatment; Poultry Phytase; Decision/Precision Ag, Enhanced Nutrient Management; *Nutrient Application Management*; and *Soil Conservation and Water Quality Plans*. Because there are no RIs for nutrient management, soil conservation and water quality plans, or manure transport, the "non-applicable" restriction pertaining to RIs has no effect on the practices included in the PSU survey.

Attachment 1 shows details contained on the VI checklists for the CBP RIs applicable to the PSU survey. For practices not considered to be RIs, practices are expected to fully meet NRCS practice standards and address CBP BMP definitions.

Survey Methodology

The PSU survey methodology details are provided in briefing materials (DEP 2016b) and a methodology report (PSU 2016). Farmers were mailed conservation practices inventory forms to complete and return to PSU. Approximately 10 percent of the responses from each county were then randomly selected for field verification by trained Extension agents. Results from farmer inventories were compared against field inventories to assess the accuracy of the method. Figure 1 provides an overview of the scope of the survey. Of an estimated 33,610 farms in Pennsylvania's portion of the Chesapeake Bay watershed, PSU sent inventories to approximately 20,000 farms. A total of 6,782 surveys were returned (34%) and approximately 10 percent of the responses (711 farms) were selected for on-site verification.
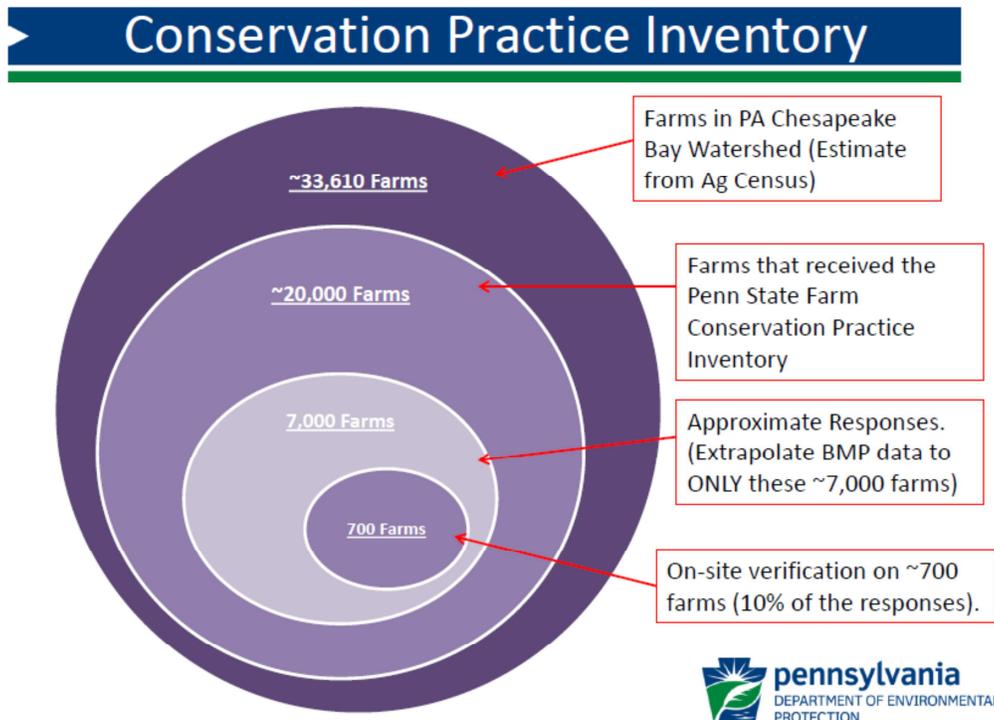
Conservation Practice Inventory

~33,610 Farms — Farms in PA Chesapeake Bay Watershed (Estimate from Ag Census)

~20,000 Farms — Farms that received the Penn State Farm Conservation Practice Inventory

7,000 Farms — Approximate Responses. (Extrapolate BMP data to ONLY these ~7,000 farms)

700 Farms — On-site verification on ~700 farms (10% of the responses).

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Figure 1. Survey sample overview

The PSU survey method best matches the CBP farm inventory method in which the farmer completes a self-certified inventory survey and trained and certified federal, state and/or county personnel verify on-site (i.e., Method 8). Information provided under *Agricultural BMP Verification Guidance* demonstrates that Method 8 can be applied to all practices included in the PSU survey. Note that poultry litter transport is the only aspect of manure transport that is addressed as a practice in Appendix B.

Two related forms were used for the survey:
- Farmer survey: *Pennsylvania Farm Conservation Practices Inventory* (Attachment 2)
- Follow-up on-site survey: *Pennsylvania Farm Conservation Practices Inventory* (Attachment 3)

Farmer Survey
Farmers were asked if they had a nutrient management plan or manure management plan, including whether it was an Act 38, NRCS 590, or manure management plan. See Attachment 2 for additional details requested.

Manure transport questions addressed the counties and states to which manure was transported, and the type (beef, dairy, poultry, or swine) and amount (tons or gallons) transported to each county/state. Farmers were also asked if they worked with a hauler or broker.

Manure storage unit information requested from farmers included the type of manure it stores, the date (month/year) it was constructed; the months of storage it provides; whether any county, state or federal government funds were used to construct it; and whether runoff from the storage

is being controlled. For barnyards farmers were asked if they had roof runoff structures, concrete barnyards, curbs, collections systems or pumps for runoff control, or barnyard runoff filter strips. They were also asked to report the construction month/year and whether public funds were used.

Farmers were asked if they had agricultural erosion and sedimentation control (E&S) plans or conservation plans. Specific details requested included plan type (E&S or NRCS), the date (month/year) it was written or updated, whether federal funds were used, and the acreage of row crops, pasture, hay, and barnyard covered by the plan.

Stream bank fencing information requested included linear feet of fencing, the linear feet funded with public funds, and the average distance from the stream to the fence. Streamside riparian buffer information included acreage, average width, presence of trees or shrubs, and the acreage funded with public funds.

See Attachment 2 for information requested regarding tillage, cover crops, and retired lands.

<u>Follow-Up On-Site Survey</u>
A total of 42 Extension agents conducted farm visits to verify the accuracy of the farmer-provided data. These Extension personnel have program responsibility and training and education in relevant disciplines such as agronomy, livestock operations, nutrient management, horticulture, and cropping systems. The majority have a Master's Degree or higher in these relevant disciplines.

Participating Extension agents attended full-day training sessions in July 2016 put on by staff from DEP, PA State Conservation Commission, Chesapeake Bay Program, and the Lancaster County Conservation District. Extension agents were trained on the visual indicators for meeting RI standards for applicable structural BMPs. Extension agents were also trained on the essential substantive elements of manure management plans and agricultural E&S Plans. Trained Extension agents then conducted farm inspections from August through September 2016.

Extension agents contacted farmers on their lists to schedule a farm visit. In order to eliminate potential for bias, the Extension agent was not provided with a copy of the farm survey filled out by the farmer. The Extension agent used a follow-up on-site survey form developed for the visits, and filled it out based on answers provided by the farmer and visual inspection of certain practices. The follow-up on-site survey form asked questions that mirrored questions on the farmer survey, as well as additional questions necessary to determine whether certain BMPs were installed and functioning sufficiently to meet Bay Program standards (PSU 2016).

Verification was not an engineering inspection that confirmed practice specifications. Instead, it was a short visual review to confirm that the BMP is in place and appears to be functional, as best can be determined by the verifier. On-site review forms, however, included a check on whether, for example, a nutrient management plan was written by a certified writer and/or planner, or whether an animal waste storage structure was certified by an engineer.

Manure management plans were only counted if they met the definition of an MMP as specified in *PA DEP Manure Management Plan (MMP) Administrative Completeness Review Guide*. Agricultural erosion and sediment (E&S) control plans were only counted if they met the definition specified in the *PADEP Agricultural Erosion and Sediment (Ag E&S) Control Plan Administrative Review Guide* (i.e., checklist) to determine whether operator's E&S Plan meets the definition of an E&S Plan. If the farmer was not able to produce a plan and the plan did not contain these essential elements, it was not counted.

The following practices were counted only if they satisfied all VIs specified in Appendix H of the verification guidance:

- RI-1 dry waste storage structure
- RI-16 barnyard clean water diversion
- RI-4a, 4b, 5, 6 watercourse access control
- RI-7, 8 grass nutrient exclusion area or buffer on watercourse example
- RI-9, 10 forest exclusion area or buffer on watercourse

The form indicates whether the farmer has an Act 38 or NRCS 590 nutrient management plan, but a clear indication of whether the plan meets relevant criteria was not found on the form. Each operator should have a copy of written Act 38 plan approval from the district or certification that an NRCS 590 plan meets NRCS standards and specifications. Neither of these certifications is specifically addressed on the follow-up on-site survey form. It is possible, however, that Extension agents were trained to check for such certification before checking the box for Act 38 or NRCS 590 plans.

The form indicates if residue is ≥60% or ≥30% but less than 60%, thus allowing the reviewer to indicate if conservation tillage or high residue, minimum soil disturbance tillage requirements are met. A separate question also addresses the acreage under continuous no-till for the past five years. Cover crop species, planting dates, nutrient applications, and harvesting plans are all recorded. For manure transport, the destinations, manure types, and manure amounts are all recorded.

See Attachment 3 for additional details.

Comparison of CBP Verification and PSU Survey Methodologies

The PSU survey does not meet the default requirement that jurisdictions verify 100% of the initial identification of non-cost-shared (privately funded) annual or multi-year structural BMPs and plan implementation. This, however, is consistent with the purpose of seeking approval to extrapolate the findings from the 10% of farms verified on-site to the total number (6,782) of survey responses as initial verification of all potentially eligible visual and non-visual non-cost-share BMPs. Information on the accuracy of the PSU survey to inform the decision regarding this request can be found under *Calculation of Measures of PSU Survey Accuracy and Completeness*.

The verification guidance does note, however, that Visual Assessment BMPs – Single Year BMPs can be statistically sub-sampled using scientifically accepted procedures. The PSU survey

therefore meets the coverage requirement for conservation tillage; high-residue minimum soil disturbance; cover crops; and annual no-till.

The PSU survey satisfies the requirement that verification be performed by trained and certified technical field staff or engineers with supporting documentation that it meets the governmental and/or CBP practice standards. Selection of farms for field verification was based on a satisfactory random-selection method.

Method 8 can be applied to the verification of all practices in the PSU survey. It should be noted, however, that Method 8 is considered only "Potentially Eligible" for Non-Visual Assessment BMPs – Single Year meeting federal/state O&M specifications, installation date, and expiration date. This potential limitation affects poultry litter transport (as an element of manure transport), nutrient application management, and soil conservation and water quality plans.

Accuracy of the Survey Method as Measured with Field Verification Data

Tt both calculated three indicators of survey method accuracy and completeness using the categorical data provided by PSU (see *Calculation of Measures of PSU Survey Accuracy and Completeness*) and reviewed the analyses performed and reported by PSU (see *Review of PSU* Analysis).

Calculation of Measures of PSU Survey Accuracy and Completeness

Data

Raw survey verification data were provided by PSU to Tt. County was identified but farm identifiers were anonymous. Data included all farm visit data compared to survey returns for all farms visited as part of the verification process, organized and analyzed on a BMP by BMP basis. In addition, PSU provided a verification survey summary which includes the statistical analysis performed for each of the BMPs, including the overall means as well as the means of the subcategories for errors (original reported acres > 0, verified acres = 0, etc.), and histograms to visualize the distributions.

For some of the practices verified (e.g., nutrient management plans), PSU classified reports by four types:

- **Category 0**: zero acres (or other units) reported in farmer survey, zero acres (or other units) reported in farm visit
- **Category 1**: positive acres reported in farmer survey, but zero acres reported in farm visit
- **Category 2**: zero acres reported in farmer survey, but positive acres reported in farm visit
- **Category 3**: positive acres reported in both farmer survey and farm visit

Method

Tt calculated three indicators of survey method accuracy and completeness using the categorical data provided by PSU. The four categories reported by PSU (Category 0-3) were converted to the possible outcomes shown in Figure 2 and Table 3. The following conversions were applied: Category 0 = d, Category 1 = b, Category 2 = c, Category 3 = a.
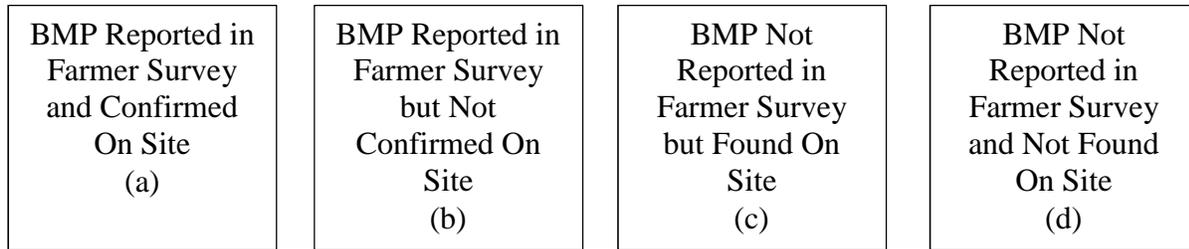
BMP Reported in Farmer Survey and Confirmed On Site (a)	BMP Reported in Farmer Survey but Not Confirmed On Site (b)	BMP Not Reported in Farmer Survey but Found On Site (c)	BMP Not Reported in Farmer Survey and Not Found On Site (d)

Figure 2. Possible outcomes for remote sensing

Table 3. Data elements used in measures of remote sensing accuracy and completeness

Farmer Survey Result	Field Observed		
	Yes	No	Marginal Total
Yes	a	b	a+b
No	c	d	c+d
Marginal Total	a+c	b+d	a+b+c+d

Three measures (Schaefer 1990) were used to characterize the accuracy and completeness of the farmer survey method.

- Proportion Correct (PC)
- Hit Rate (HR)
- False Alarm Ratio (FAR)

All three measures can be calculated using the data illustrated in Table 3.

Proportion Correct (PC)
The PC is a measure of the accuracy of the survey method calculated as the percentage of survey responses that are confirmed via farm visit, i.e., BMP presence or absence was correctly determined. The range for the PC is 0 to 1, with a value of 1 indicating a perfect survey. The PC is a frequently used measure because, unlike the FAR, it takes into account both false positives and missed events, and is therefore a more balanced score. The PC is calculated as:

$$PC = (a + d)/(a + b + c + d) \tag{1}$$

Hit Rate (HR)
HR ranges from 0 to a perfect score of 1. Because the formula contains reference to "c" (misses) and not to "b" (false positives), the hit rate is sensitive to missed BMPs and not falsely reported BMPs.

$$H = a/(a + c) \tag{2}$$

False Alarm Ratio (FAR)

FAR is the fraction of survey-reported BMPs that were not confirmed via farm visit. The number of missed BMPs is not considered in the FAR. For this reason, H and FAR should both be considered for a better understanding of the performance of the remote sensing.

$$FAR = b/(a + b)$$

(3)

Results

Confidence Interval for a Binomial Distribution

PC values for field verification can be represented by a binomial distribution. In a binomial distribution there are two mutually exclusive options, e.g., Yes or No, Correct or Incorrect. The following equation may be used to estimate the confidence interval of the proportion of Yes values (p) (https://onlinecourses.science.psu.edu/stat414/node/264):

$$p \pm Z_{1-\alpha/2}\sqrt{\left(\frac{p(1-p)}{n}\right)\cdot\left(\frac{N-n}{N-1}\right)}$$

(4)

where
       p = proportion of "yes" responses
       N = total number of population units in sample population
       n = number of samples
       $Z_{1-\alpha/2}$ = value corresponding to cumulative area of 1-α/2 using the normal distribution
       (e.g., 1.645 for 90% confidence level, 1.96 for 95% confidence level)

The second term under the square root operator accounts for finite populations (N).

There are two outcomes from the field verification:

- BMP presence correctly determined via survey (a+d)
- BMP presence incorrectly determined via survey (b+c)

In this case, an incorrect identification includes both false positives and misses. The proportion of correct or "yes" responses (p in the binomial equation) and number of samples can be represented mathematically by:

$$Proportion\ Correct = p = \frac{a+d}{a+b+c+d} = \frac{a+d}{n} = PC$$

(5)

The value of N is 6,782 which was the total number of survey results submitted by farmers. Using the above values for a, b, c, n, and N, values for all three measures, including 90 percent confidence intervals for PC, were calculated and summarized in Table 4. Note that Table 4 includes practices, practice subcategories, and practice attributes (e.g., buffer acres, buffer width), all of which are collectively referred to as "BMP variables" in this discussion.

Table 4. Measures of survey accuracy and completeness

Practice	Subcategory	n	Proportion Correct (PC)				Hit Rate (HR)	False Alarm Ratio (FAR)	Group
			p	α	Half-Width PC	PC Range at 90% Confidence Level			
Nutrient Management Plan Acres	Row Crop Acres	711	0.85	0.1	0.02	83-87%	0.77	0.13	1
	Pasture Acres	711	0.81	0.1	0.02	78-83%	0.62	0.19	1
	Hay Acres	711	0.80	0.1	0.02	78-82%	0.67	0.24	1
	Privately Funded Act 38 Row Crop Acres	711	0.93	0.1	0.01	92-95%	0.26	0.46	2
	Privately Funded Act 38 Pasture Acres	711	0.94	0.1	0.01	92-95%	0.14	0.60	3
	Privately Funded Act 38 Hay Acres	711	0.93	0.1	0.01	92-95%	0.09	0.69	3
	Privately Funded NRCS 590 Row Crop Acres	711	0.95	0.1	0.01	94-96%	0.21	0.68	3
	Privately Funded NRCS 590 Pasture Acres	711	0.97	0.1	0.01	96-98%	0.24	0.71	3
	Privately Funded NRCS 590 Hay Acres	711	0.95	0.1	0.01	94-97%	0.23	0.75	3
	Manure Management Plans on Row Crop Acres	711	0.84	0.1	0.02	82-86%	0.61	0.39	4
	Manure Management Plans on Pasture Acres	711	0.84	0.1	0.02	82-86%	0.49	0.40	4
	Manure Management Plans on Hay Acres	711	0.85	0.1	0.02	83-87%	0.60	0.43	4
	Advanced Nutrient Management	711	0.83	0.1	0.02	81-86%	0.35	0.69	2
E&S Plans	Row Crop Acres	711	0.90	0.1	0.02	89-92%	0.30	0.46	2
	Pasture Acres	711	0.92	0.1	0.02	91-94%	0.30	0.48	2
	Hay Acres	711	0.93	0.1	0.02	91-94%	0.27	0.44	2
	Barnyard Acres	711	0.96	0.1	0.01	94-97%	0.17	0.73	3
NRCS Plans (privately funded)	Row Crop Acres	711	0.81	0.1	0.02	79-84%	0.35	0.57	2
	Pasture Acres	711	0.86	0.1	0.02	84-88%	0.28	0.58	2
	Hay Acres	711	0.85	0.1	0.02	83-87%	0.31	0.58	2

Practice	Subcategory	n	Proportion Correct (PC)				Hit Rate (HR)	False Alarm Ratio (FAR)	Group
			p	α	Half-Width PC	PC Range at 90% Confidence Level			
	Barnyard Acres	711	0.94	0.1	0.01	92-95%	0.16	0.78	3
Stream Bank Fencing	Fencing Length (Ft.)	711	0.88	0.1	0.02	86-90%	0.71	0.15	1
	Distance from Stream to Fence (Ft.)	711	0.87	0.1	0.02	86-89%	0.74	0.19	1
	Public Funded Fencing (Ft.)	711	0.93	0.1	0.01	92-95%	0.69	0.25	1
	Privately Funded Fencing (Ft.)	711	0.87	0.1	0.02	86-89%	0.53	0.30	4
	Acres of Buffer	711	0.87	0.1	0.02	85-89%	0.70	0.19	1
	Acres of Privately Funded Buffer	711	0.87	0.1	0.02	85-89%	0.53	0.34	4
Riparian Buffers	Buffer Acres	711	0.71	0.1	0.03	68-73%	0.45	0.50	5
	Privately Funded Buffer Acres	711	0.77	0.1	0.02	74-79%	0.29	0.70	2
	Buffer Width	711	0.71	0.1	0.03	68-73%	0.48	0.49	5

Interpretation of the data for PC, H, and FAR in Table 4 is aided by cluster analysis, a statistical procedure that groups a set of objects (BMP variables in this case) in such a way that objects in the same group (or cluster) are more similar (based on PC, H, and FAR scores) to each other than to those in other groups. The user can specify the number of groups, and in this case five groups resulted in the best result for this report. The rightmost column of Table 4 shows the results of cluster analysis assuming five groups. It can be seen that only two BMP variables are in group 5, while five BMP variables are in group 4, seven BMP variables are in each of groups 1 and 3, and nine BMP variables are in group 2.
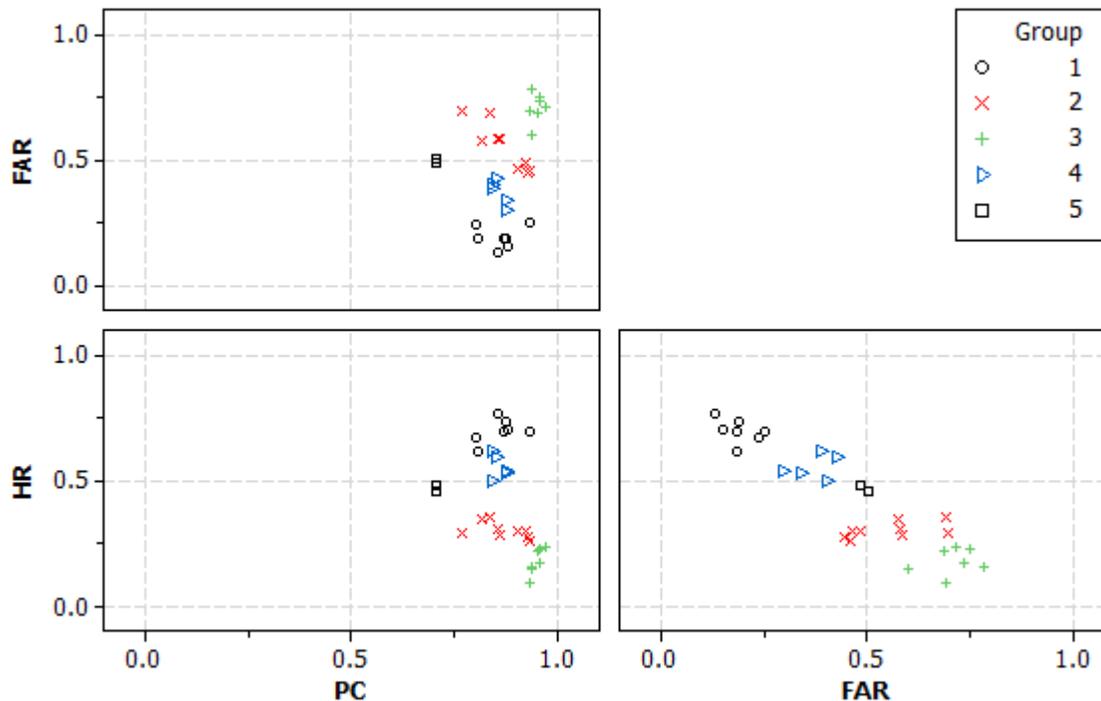
Figure 3. Cluster analysis results

The lowest PC values were found for riparian buffer acres and width (68-73%), whereas the highest PC values were found for privately funded NRCS 590 plans on pasture (96-98%). Overall, however, the data in Table 4 and Figure 3 generally indicate that the survey approach used by PSU is reliably accurate. Because it has statistically valid samples, PSU could develop coefficients to adjust survey results based on verification findings to correct for errors in over- or under-reporting.

Group 1 BMP variables had PC values ranging from 78-82% to 92-95%, FAR values ranging from 13-25%, and HR values ranging from 62-77%. BMP variables in group 1 include row crop, pasture, and hay acres under nutrient management plans; stream bank fencing acres; distance from fence to stream bank; feet of publicly funded fencing; and acres of buffer created by stream bank fencing.

Group 2 BMP variables had PC values ranging from 74-79% to 92-95%, FAR values ranging from 44-70%, and HR values ranging from 26-35%. BMP variables in this group include privately funded acres of row crop with Act 38 nutrient management plans; advanced nutrient management acres; row crop, pasture, and hay acres with E&S plans; row crop, pasture, and hay acres with privately funded NRCS plans; and privately funded riparian buffer acres.

Group 3 BMP variables generally had higher PC values, lower HR values, and greater FAR values. The group 3 BMP variables (privately funded acres of pasture and hay with Act 38 nutrient management plans; privately funded acres of row crops, pasture, and hay with NRCS 590 nutrient management plans; barnyard acres with E&S plans; and barnyard acres with NRCS

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plans) generally had generally high PC values (93-97%), but these can be attributed to the large proportion of "not reported/not found" results. However, the greater FAR values for group 3 (60-78%) indicate over-reporting (i.e., "reported/not found"). The low HR values (9-23%) indicate an under-reporting where "not-reported/found" results outweigh the "reported/found" results.

Group 4 BMP variables had PC values ranging from 82-86% to 86-89%, FAR values ranging from 30-43%, and HR values ranging from 49-61%. BMP variables in this group include acres of row crops, pasture, and hay with manure management plans; feet of privately funded stream bank fencing; and acres of privately funded buffer created by stream bank fencing.

Group 5 BMP variables had PC values ranging from 68-73%, FAR values ranging from 49-50%, and HR values ranging from 45-48%. BMP variables in this group include riparian buffer acres and width of privately funded riparian buffers.

County-level Results

In the previous section, PC, FAR, and HR values were calculated for all counties combined. However, the Bay model uses county-level data. For this reason, it may be useful to consider county-to-county level variations in these indicators. County-level values of PC, FAR, and HR were calculated for row crop acres under nutrient management plans as a test of county-to-county variability. For this example, the results plotted in Figure 4 illustrate that county-level values of PC, FAR, and HR do not generally deviate much from the overall value (represented by solid blue triangles). In fact where there were at least 20 observations per county the deviation from the overall value was markedly smaller. Because this is only one BMP variable, Tt recommends further analyses might be warranted to determine if county-to-county variability is of concern. It is acknowledged that small sample sizes for some counties might limit the extent of this investigation.
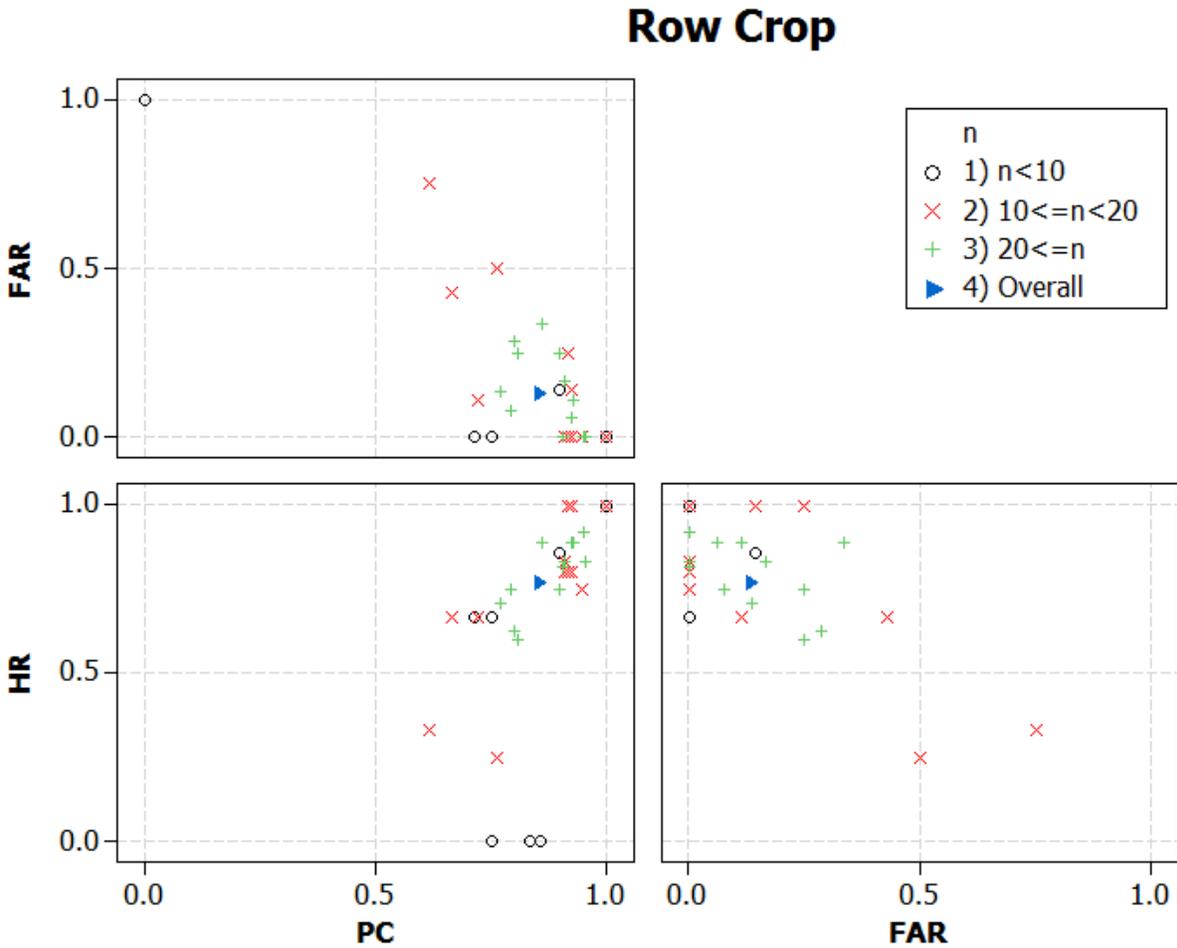
Figure 4. Bivariate plot of FAR, HR, and PC by county for nutrient management plan acres/row crop

Review of PSU Analysis

For each BMP (and relevant subcategories), PSU calculated the difference between the farmer-reported value and the on-site verification value as the farmer-reported value minus the on-site verification value (PSU 2016). PSU performed statistical analyses on this difference value. If the mean of any difference column was not statistically different from zero then PSU concluded that there was no systematic over- or under-reporting for that practice. PSU looked at the overall mean to make this determination, but also broke down the analysis according to how much of the sample fell into the four categories described above (see *Data*).

This breakdown into categories is intended to supplement the analysis of the overall mean differences. Response pairs in Categories 1 and 2 represent qualitative errors, whereas Category 3 could more likely represent a quantitative error. This analysis is summarized in the file *BMP survey verification summary.docx*.

In addition to the analysis of means, PSU created histograms for each practice to give a visual representation of the distribution of the difference variables. In some cases, PSU found that dropping one or two observations had a large impact on the means and variances. For this reason

they presented results for the summary statistics both with and without some of these outliers. The histograms excluded these outliers. Tt performed its analyses using all data (see *Calculation of Measures of PSU Survey Accuracy and Completeness*), but did not investigate differences in reported acreage, etc.

The methods applied by PSU are both logical and sound given the purpose of the survey. Tt recommends, however, that PSU explore county-to-county variability to ensure that county-level data will be as reliable as aggregate data. In addition, Tt recommends that all estimates of BMP implementation be accompanied by error margins at a specified level of statistical confidence. Tt concurs with the goal of limiting extrapolation of on-site review findings to only those surveys that were completed. There is likely to be a bias in those surveys that were not returned, something that would need to be examined through a non-response bias analysis.

PSU Conclusions

It was concluded that there was no systematic over- or under-reporting for nearly all BMPs (Royer 2016). The exceptions to this are barnyard acres under E&S/NRCS plans and riparian buffers. These practices both showed systematic over-reporting.

Because their analysis showed that the over-reporting of these particular practices is statistically significant, PSU believes that an adjustment factor could be applied to adjust the cumulative dataset downward.

PSU also believes that the systematic over-reporting of riparian buffer acres may be attributed to differences in the way the questions were asked in the farm survey regarding buffers and stream bank fencing, and how Extension agents were trained to record these answers during the farm visits. It is suspected that, based on how the questions were worded in the survey, farmers largely reported all buffer acres (including those created by stream bank fencing) in answer to the riparian buffer question. It is further suspected that, based on the training given to Extension agents in July, Extension agents recorded buffers created by fencing in answer to the fencing question, and recorded other buffers (those not created by fencing) in response to the riparian buffer question.

Summary

The PSU survey included practices that can be matched with BMPs and RIs used in the Bay Model. Some details will need to be worked out, particularly if the Phase 6 nutrient management BMPs are approved.

The survey was designed as a test alternative to the CBP requirement that initial verification of most practices requires inspection of all practices with the exception of visual assessment for single-year BMPs. (The single-year BMPs can be statistically sub-sampled.) Statistical analyses were performed to inform decisions regarding the suitability of this approach for initial practice verification.

Field verification methods addressed both practices that adhered to USDA or state design specifications for BMPs and those that were verified with VIs for RIs. Training and staff expertise satisfied CBP verification guidance requirements.

Analyses by both PSU and Tt demonstrate that the survey method is largely accurate for most practices included in the study. This accuracy, however, is based on the aggregate sample. Tt recommends additional analysis to determine county-to-county variability of accuracy. Further, under- or over-reporting can and should be addressed to ensure the most accurate county-level reporting for credit in the Bay model.

References

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Attachments

Attachment 1. Visual indicator checklists for CBP RIs

CBP RI Practice	Assessment Method (All RIs fall under Visual Assessment BMP - Multi-Year)
RI-9, 10: Forest Nutrient Exclusion Area or Buffer on Watercourse Resource Improvement Practice, Forest Nutrient Exclusion Area on Watercourse (RI9), Forest Buffer on Watercourse (RI10)	Requires visual observation for the following: • Dominant vegetation (>50% canopy cover) consists of existing, natural regenerated, or planted trees and/or shrubs. • Overland/sheet flow through buffer is maximized (no concentrated flow). • Structural measures are present where vegetation practice is insufficient to control erosion. Requires estimate by paces that: • Perpendicular distance from top-of-bank of stream, ditch, or tidal area ≥10' minimum average for width of buffer. Requires the following recorded values on checklist: • Length in feet • Width in feet
RI-7, 8: Grass Nutrient Exclusion Area or Buffer on Watercourse Resource Improvement Practice	Requires visual observation for the following: • Overland flow through buffer is maintained as sheet flow. • All excessive sheet-rill and concentrated flow are controlled in areas immediately adjacent & up-gradient of buffer, before entering. • No livestock are present nor have access. Owner interview also required for this. • Plant species are native (preferred), or introduced and non-invasive, with stiff stems and high stem density. • Plants are compatible in growth rate, tolerant of flooding/saturation and shade. • Minimum of 75% perennial grass cover is present. Requires estimate by paces that: • Horizontal buffer width ≥10' measured perpendicular to top-of-bank intermittent stream, ditch, or tidal area • Width is ≥35' if receiving dissolved contaminants (e.g., nutrients, pesticides). Visual observation also required for this. Requires the following recorded values on checklist: • Length in feet • Width in feet
RI-16: Barnyard Clean Water Diversion	Requires visual observation for the following: • Surface outlet is stable; downspouts have elbow and dissipation device directed away from buildings, as appropriate. • Gutter-less system has stone-filled, collection trench under entire roof drip line; width ≥24", depth ≥24". Owner interview also required for this. • Drip line stone extends along sides of and over pipe. • Gutter is K-style, half-round, or box-type on good-condition vertical fascia board, free floating on supports, and ≥5" top width. Roof rafter ends are sound. • Downspout avoids mix with waste. • The system is sound and functioning.

CBP RI Practice	Assessment Method (All RIs fall under Visual Assessment BMP - Multi-Year)
	• Downspouts are securely fastened at top and bottom, with intermediate supports ≤10', installed appropriately. • Gutter and downspout are protected from livestock. Otherwise made of steel pipe, Sch40, or similar. • Clean surface runoff is directed away from barnyard area.
RI-4a, 4b, 5, 6: Watercourse Access Control Resource Improvement Practice, (RI-4a) Watercourse Access Control-Narrow Grass, (RI-4b) Watercourse Access Control-Narrow Trees, (RI-5) Watercourse Access Control-Grass, (RI-6) Watercourse Access Control-Trees	Requires visual observation for the following: • Exclusion method controls the intended animals. Owner interview also required for this. • Livestock concentration and grazing are minimized in riparian (wetland, stream) areas. • Areas around fence are stabilized. • Vegetation in buffer between the barrier and surface water are of a density to help reduce sediment, organic material, nutrients, pesticides, and other pollutants in surface runoff. • Exclusion method is determined to be critical to confinement/exclusion from environmental area. Requires the following recorded values on checklist: • Length in feet • Width in feet
RI-1: Dry Waste Storage Structure	Requires visual observation for the following: • Facility operates without polluting waters. • Offsite runoff is excluded or accounted for in storage. • Storage of stackable manure must meet all state and local regulations. All runoff is controlled and non-polluting. Owner interview also required for this. • No safety concerns present. • Slab on grade, or may be other stabilized impervious surface. • Retaining wall if used is straight, not in imminent danger of failure. Requires estimate by paces that: • Facility is located ≥100' from wells unless there is a waiver. • Facility is 100' from top of bank of any stream or per state, county, or local regulation. Requires owner interview to confirm volume per sizing sheet for NRCS Spec or to describe management methodology used by farmer. Requires the following recorded values on checklist: • Number of systems • Animal type and animal units

Attachment 2. Farmer survey

Pennsylvania Farm
Conservation Practices Inventory

Instructions

Thank you for agreeing to participate in this inventory of conservation practices on Pennsylvania farms. Please have the individual with the best knowledge of the conservation practices used in your operations complete the inventory.

The inventory will be used to determine the amount of conservation practice adoption on Pennsylvania farms. Cumulative results will be provided to the Pennsylvania Department of Environmental Protection to document the practices that Pennsylvania farmers are doing to conserve soil and water, and protect water quality. Ten percent of the participants in this inventory will be randomly selected for farm visits by Penn State Extension to assess the accuracy of the overall inventory.

Please be assured that your responses will be kept completely confidential and your results will never be associated with your name or locational information. The results reported to the Department of Environmental Protection will be provided in summary form and will not include any names or locations of inventory participants. Names and addresses will be removed from all inventory and farm visit results to prevent idenfification of participants.

Please answer each question to the best of your knowledge. Where the question asks you to fill in a circle, please fill the circle completely. Where the question asks you to write an answer, please print legibly.

The first part of this inventory asks basic questions about your farming operations. The second part of the inventory asks whether you are practicing certain conservation practices in your farming operations, and then asks some additional questions about each practice. Some of the practices listed may not be applicable to your operation. If you do not utilize a practice, answer "No" and continue on to the next question.

Please submit your completed inventory to the Penn State Survey Research Center by April 30, 2016.

About Your Farming Operations

1. Please provide your name and the physical address of your farming operation.

First Name   **I**   **Last Name**

Number & Street Address

City   **State**   **Zip Code**

Municipality (township, borough, etc.)   **County**

Watershed, if known: ○ Delaware   ○ Erie   ○ Genessee   ○ Ohio   ○ Potomac   ○ Susquehanna

2. How many acres is your farming operation? For purposes of answering this question and filling out the remainder of the survey, your farming operation includes all land which you manage for agricultural activities, including owned ground and rented ground.

[ ] Number of acres

3. For calendar year 2015, please indicate what crops you grew, how many acres of each, whether they were grown on owned or rented ground, and whether any of the acres grown were a double crop.

Crop	Acres on Owned Ground	Acres on Rented Ground	Acres Grown as a Double Crop
Corn Grain			
Corn Silage			
Soybeans			
Wheat			
Rye			
Barley			
Alfalfa			
Hay			
Other (please specify): _____			

4. **Do you raise animals as part of your farming operation?**

    ○ No → Please proceed to Question 5.

    ○ Yes → 4a. For calendar year 2015, please indicate what types of animals you had and the total annual head of each.

Animal	Number	Animal	Number	Animal	Number	Animal	Number
Broilers		Nursery Pigs		Veal Calves		Beef Cattle	
Layers		Finisher Pigs		Dairy Heifers (12 mos. & younger)		Horses	
Turkeys		Sows		Dairy Heifers (older than 12 mos.)		Other_____	
Ducks		Boars		Cows (Milking and dry)		Other_____	

Your Conservation Practices

5. **Do you have a nutrient management plan or manure management plan for your farming operations?**

    ○ No → Please proceed to Question 6.

    ○ Yes → 5a. What type of plan do you have?

        ○ Act 38 Nutrient Management Plan

        ○ NRCS 590 Nutrient Management Plan or Comprehensive Nutrient Management Plan

        ○ Manure Management Plan

    5b. When was it written or last updated? ☐☐ / ☐☐☐☐ Month/Year

    5c. Were any county, state or federal government funds used to develop your plan? ○ No ○ Yes

    5d. From whom or where did you get information to assist you in preparing the plan? (select all that apply)

        ○ Conservation District one-on-one assistance

        ○ Conservation District workshop

        ○ USDA NRCS

        ○ Penn State Extension

        ○ Private sector/nutrient management planner

        ○ Certified crop advisor

        ○ None

        ○ Other (please specify): _____

    5e. Indicate how many acres are covered by your nutrient management plan:

Land Type	Acres
Row Crops (corn, beans, small grains)	☐☐☐☐
Pasture	☐☐☐☐
Hay	☐☐☐☐

6. **Do you perform nitrogen tests such as the Pre-side dress Nitrate Test (PSNT), Corn Stalk Nitrate Test (CSNT), Illinois Soil Nitrogen Test (ISNT), Fall Soil Nitrate Test (FSNT), or Variable N rate application?**

    ○ No → Please proceed to Question 7.

    ○ Yes → 6a. Do you use the test results to change nitrogen application rates and/or timing?

        ○ No

        ○ Yes → 6b. On how many acres of cropland do you use these nitrogen test methods to adjust recommendations? ☐☐☐☐☐ Acres

7. Is any manure produced from your farming operation transported out of the county in which your farming operations are located?

   O No → **Please proceed to Question 8.**

   O Yes, and I know to which county or counties my manure is transported

   O Yes, but I don't know the county or counties to which my manure is transported; a hauler or broker handles this for me.

   7a. If you know to which county or counties your manure is transported, please list the top three counties and/or states that receive your manure. Indicate the type of manure transported, the county(ies) and state(s) to which your manure is transported, the approximate annual amount that is transported to each location, and whether you worked with a manure hauler or broker to transport your manure.

County and State to which manure is transported	Manure Type	Approximate annual amount transported	Unit	Did you work with a hauler or broker?
1.	O Dairy O Swine O Beef O Poultry		O Tons O Gallons	O No O Yes
2.	O Dairy O Swine O Beef O Poultry		O Tons O Gallons	O No O Yes
3.	O Dairy O Swine O Beef O Poultry		O Tons O Gallons	O No O Yes

8. Do you have any animal waste storage systems (manure storages) for your farming operations?

   O No → **Please proceed to Question 9.**

   O Yes → **8a. For each manure storage you have, indicate the type of manure it stores, the date it was constructed, the months of storage it provides, whether any county, state or federal government funds were used to construct it, and whether runoff from the storage is being controlled.**

	Manure Type	Month/Year Constructed	# of Months of Storage Provided	Were county, state or federal funds used to construct your storage?	Is runoff controlled from your storage system?
1	O Dairy O Swine O Beef O Poultry	☐☐ / ☐☐☐☐	☐☐	O No O Yes	O No O Yes
2	O Dairy O Swine O Beef O Poultry	☐☐ / ☐☐☐☐	☐☐	O No O Yes	O No O Yes
3	O Dairy O Swine O Beef O Poultry	☐☐ / ☐☐☐☐	☐☐	O No O Yes	O No O Yes
4	O Dairy O Swine O Beef O Poultry	☐☐ / ☐☐☐☐	☐☐	O No O Yes	O No O Yes
5	O Dairy O Swine O Beef O Poultry	☐☐ / ☐☐☐☐	☐☐	O No O Yes	O No O Yes

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9. Do you have any barnyards?

  ○ No → **Please proceed to Question 10.**

  ○ Yes → **9a. Do you have any barnyard runoff controls on these barnyards? (This includes practices such as roof runoff control, diversion of clean water from entering the barnyard, and control of runoff from barnyard areas.)** ○ No → **Please proceed to Question 10.**

  ○ Yes → **9b. Indicate what kind of runoff control practices you have, when they were built, and whether any county, state or federal government funds were used to construct them.**

Runoff Control Practice	Do you have this practice?	Month/Year Constructed	Were county, state or federal funds used to construct the practice?
Roof runoff structures (gutters, downspouts, outlets)	○ No ○ Yes	☐☐ / ☐☐☐☐	○ No ○ Yes
Concrete barnyards	○ No ○ Yes	☐☐ / ☐☐☐☐	○ No ○ Yes
Curbs	○ No ○ Yes	☐☐ / ☐☐☐☐	○ No ○ Yes
Collection system and/or pumps	○ No ○ Yes	☐☐ / ☐☐☐☐	○ No ○ Yes
Barnyard runoff filter strip	○ No ○ Yes	☐☐ / ☐☐☐☐	○ No ○ Yes

10. Do you have any Agricultural Erosion & Sedimentation Control Plans (E&S Plans) or Conservation Plans for your farming operations?

  ○ No → **Please proceed to Question 11.**

  ○ Yes → **10a. For each plan you have, indicate the type of plan, when it was written or last updated, whether any federal government funds were used to develop your plan, and the acres of each land type covered by your plan:**

	Plan Type	Month/Year Written or Updated	Were Federal funds used to develop your plan?	Type and Number of Acres Covered by Plan			
				Land Type	# of Acres	Land Type	# of Acres
1	○ E&S Plan ○ NRCS Conservation Plan	☐☐ / ☐☐☐☐	○ No ○ Yes	Row Crops Pasture	☐☐☐☐ ☐☐☐☐	Hay Barnyard	☐☐☐☐ ☐☐☐☐
2	○ E&S Plan ○ NRCS Conservation Plan	☐☐ / ☐☐☐☐	○ No ○ Yes	Row Crops Pasture	☐☐☐☐ ☐☐☐☐	Hay Barnyard	☐☐☐☐ ☐☐☐☐
3	○ E&S Plan ○ NRCS Conservation Plan	☐☐ / ☐☐☐☐	○ No ○ Yes	Row Crops Pasture	☐☐☐☐ ☐☐☐☐	Hay Barnyard	☐☐☐☐ ☐☐☐☐
4	○ E&S Plan ○ NRCS Conservation Plan	☐☐ / ☐☐☐☐	○ No ○ Yes	Row Crops Pasture	☐☐☐☐ ☐☐☐☐	Hay Barnyard	☐☐☐☐ ☐☐☐☐
5	○ E&S Plan ○ NRCS Conservtion Plan	☐☐ / ☐☐☐☐	○ No ○ Yes	Row Crops Pasture	☐☐☐☐ ☐☐☐☐	Hay Barnyard	☐☐☐☐ ☐☐☐☐

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11. Did you practice no till or minimum till in calendar year 2015?

○ No → Please proceed to Question 12.

○ Yes → 11a. Indicate how many acres meet the following amounts of residue left in the field at the time of planting:

Amount of Residue	Acres
60% or greater	☐☐☐☐☐
30% or greater, but less than 60%	☐☐☐☐☐

11b. How many of your acres have been in continuous no till for the last five years? ☐☐☐☐☐ Acres

12. Did you plant cover crops in calendar year 2015?

○ No → Please proceed to Question 13.

○ Yes → 12a. Fill out the chart below to indicate what species you planted, when they were planted, number of acres for each, whether they received a nutrient application, and whether you harvested or plan to harvest them:

Species	Date of Planting	Acres Planted	Nutrient Application?	Harvesting?
Rye	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes
Wheat	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes
Barley	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes
Oats	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes
Annual Rye grass	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes
Annual Legumes	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes
Triticale	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes
Mixture (specify):	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes
Other (specify):	☐☐ / ☐☐ / 1 5	☐☐☐☐☐	○ No ○ Yes	○ No ○ Yes

13. Is there any stream bank fencing on land that is part of your farming operation?

○ No → Please proceed to Question 14.

○ Yes → 13a. How many total linear feet of stream bank fencing do you have? (If fencing is on both sides of the stream, include each side as part of this total.) ☐☐☐☐ feet

13b. What is the average distance from the stream to the fence? ☐☐☐☐ feet

13c. Were any county, state or federal government funds used to construct this fencing?

○ No → Please proceed to Question 14.

○ Yes → 13d. How many linear feet of stream bank fencing was funded using county, state or federal government funds?

☐☐☐☐ feet

14. Do you have any streamside riparian buffers on land that is part of your farming operation?

    ○ No → Please proceed to Question 15.

    ○ Yes → 14a. How many acres is the buffer? ☐☐☐☐☐ acres

              14b. What is the average width of the buffer? ☐☐☐☐ feet

              14c. Are trees and/or shrubs growing in the buffer? ○ No   ○ Yes

              14d. Were any county, state or federal government funds used to construct this buffer?

                  ○ No → Please proceed to Question 15.

                  ○ Yes → 14e. How many acres of buffer was funded using county, state or federal government funds? ☐☐☐☐☐ acres

15. Excluding any riparian buffers identified in your answer to Question 14, have you retired any cropland from your farming operation to permanent vegetation such as perennial grasses, trees or shrubs?

    ○ No → Please proceed to Question 16.

    ○ Yes → 15a. Indicate what year you retired your cropland, how many acres have been retired, and whether trees and/or shrubs are growing in the retired acreage.
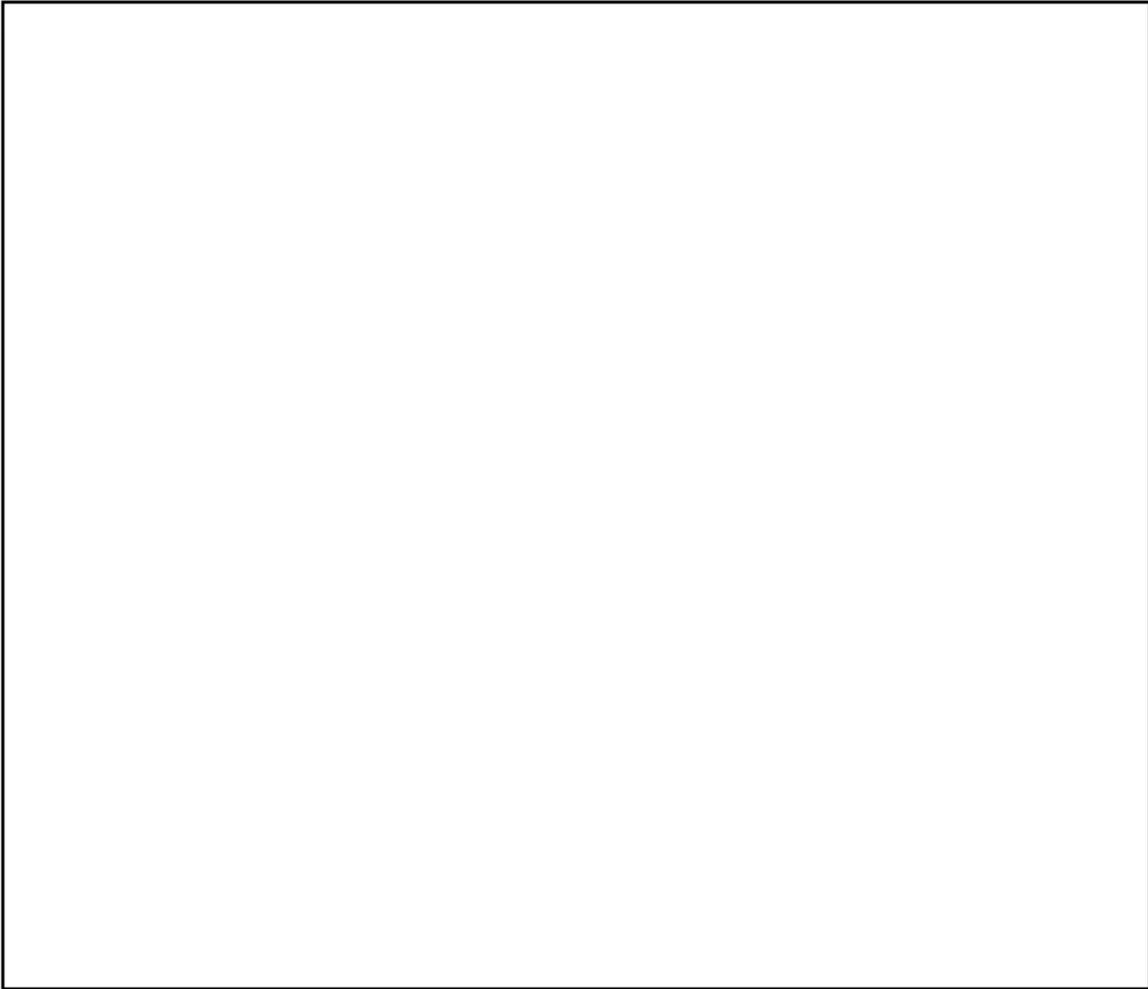
Year	Acres	Are trees and/or shrubs growing?
☐☐☐☐	☐☐☐☐☐	○ No ○ Yes
☐☐☐☐	☐☐☐☐☐	○ No ○ Yes
☐☐☐☐	☐☐☐☐☐	○ No ○ Yes

    15b. Were any county, state or federal government funds used to retire this acreage?

         ○ No → Please proceed to Question 16.

         ○ Yes → 15c. How many acres of retired cropland was funded using county, state or federal government funds? ☐☐☐☐☐ acres

16. Please feel free to share any comments, thoughts or questions you may have.

Attachment 3. Follow-up on-site survey

Name of Individual Completing Report: _____

Start Time: _____   End Time: _____   Date: _____

Pennsylvania Farm
Conservation Practices Inventory
Farm Visit Report

Unique ID #:_____   **Is this farm in the Chesapeake Bay Watershed?** o Yes   o No

1. **Does the operator have a nutrient management plan or manure management plan?**
   - o No →   **Please proceed to question 2.**
   - o Yes →   **1a. What type of plan?**
     - o Act 38 Nutrient Management Plan
     - o NRCS 590 Nutrient Management Plan or Comprehensive Nutrient Management Plan
     - o Manure Management Plan
     - o Other (specify) _____

   NOTE: Use the PADEP Manure Management Plan (MMP) Administrative Completeness Review Guide (i.e., checklist) to determine whether operator's MMP meets the definition of an MMP. If it does not meet the definition of an MMP, do not count it as such.

     1b. When was it written or last updated? _____ (Month/Year)
     1c. Was the plan written by a certified writer and/or planner? _____ (Name)
     1d. Were any county, state or federal government funds used to develop the plan?
     - o No
     - o Yes →   o County funds   o State funds   o Federal funds   (check all that apply)

     1e. From whom or where did the operator get information to assist in preparing the plan? (Select all that apply)
     - o Conservation District one-on-one assistance
     - o Conservation District workshop
     - o Penn State Extension
     - o Private sector/nutrient management planner
     - o Certified crop advisor
     - o None
     - o Other _____

     1f. Indicate how many acres are covered by the nutrient management or manure management plan:

Land Type	Acres
Row Crops (corn, beans, small grains)	
Pasture	
Hay	

2. **Does the operator perform nitrogen tests such as the Pre-side dress Nitrate Test (PSNT), Corn Stalk Nitrate Test (CSNT), Illinois Soil Nitrogen Test (ISNT), Fall Soil Nitrate Test (FSNT), or Variable N rate application?**
   - o No →   **Proceed to question 3.**
   - o Yes →   **2a. Does the operator use the test results to change nitrogen application rates and/or timing?**
     - o No
     - o Yes → **2b. On how many acres of cropland does the operator use these nitrogen test methods to adjust recommendations?** _____ acres

1

3. Is any of the manure produced from the farming operation transported out of the county in which the farming operations are located?

o No →   Please proceed to question 4.

o Yes, and the operator knows which county or counties the manure is transported.

o Yes, but the operator doesn't know the county or counties to which manure is transported because a hauler or broker handles this.

3a. If the operator knows to which county or counties manure is transported, list the top three counties and state that receive manure. Indicate the type of manure transported, the counties and states to which the manure is transported, the approximate annual amount to each location, and whether the operator worked with a hauler or broker.

County and State to which manure is transported	Manure Type	Approximate annual amount transported	Unit	Work with a hauler or broker?
	o Dairy o Swine o Beef o Poultry o Equine o Other		o Tons o Gallons	o No o Yes
	o Dairy o Swine o Beef o Poultry o Equine o Other		o Tons o Gallons	o No o Yes
	o Dairy o Swine o Beef o Poultry o Equine o Other		o Tons o Gallons	o No o Yes

3b. (This question only applies to farms in Berks, Cambria, Cameron, Chester, Clearfield, Elk, Indiana, Jefferson, Luzerne, Lackawanna, McKean, Potter, Schuylkill, Somerset and Wayne Counties). Is any of the manure produced from the farming operation transported out of the Chesapeake Bay watershed?

o No →   Please proceed to question 4.

o Yes →   Indicate the type of manure transported, the approximate annual amount transported out of the Chesapeake Bay watershed, and whether the operator worked with a hauler or broker.

Manure Type	Approximate annual amount transported	Unit	Work with a hauler or broker?
o Dairy o Swine o Beef o Poultry o Equine o Other		o Tons o Gallons	o No o Yes

4. Does the operator have any animal waste storage systems (manure storages)?

o No →   Please proceed to question 5.

o Yes →   4a. For each manure storage, indicate the type of manure it stores, the date it was constructed, the storage capacity (in months and tons/gallons), the number of animals producing the manure stored, whether any county, state or federal government funds were used to construct it, whether runoff from the storage is being controlled, whether the storage is for stackable (dry) or liquid manure, and certified engineer/company who designed/built the storage system (if known).

NOTE: For stackable (dry) storages, if the storage was not funded with government funds, use the Chesapeake Bay Program Resource Improvement Practices (RI) Appendix H RI-1 Dry Waste Storage Structure Example Checklist to verify if the structure meets the definition of a stackable (dry) manure storage. If it does not meet all applicable visual indicators, do not count it as a storage.

Manure Type	Date Constructed (Month/Year)	Storage Capacity	# of Animals	Were county, state or federal funds used to construct your storage?	Runoff controlled?	Stackable or Liquid?	Certified engineer/co.?
o Dairy o Beef o Swine o Equine o Other _____		_____ months _____ tons or gallons		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes	o S o L	o No o Yes Name: _____
o Dairy o Beef o Swine o Equine o Other _____		_____ months _ tons or gallons		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes	o S o L	
o Dairy o Beef o Swine o Equine o Other _____		_____ months _ tons or gallons		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes	o S o L	
o Dairy o Beef o Swine o Equine o Other _____		_____ months _ tons or gallons		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes	o S o L	
o Dairy o Beef o Swine o Equine o Other _____		_____ months _ tons or gallons		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes	o S o L	

*Sources of funds could be Growing Greener, EQIP, Chesapeake Bay, PennVest, REAP, Section 319, NFWF, etc.

4b. For all stackable (dry) manure storages which are not funded using government funds, all visual indicators and the definition provided by CBP RI-1 (Dry Waste Storage) have been met.

o No   o Yes

5. Does the operator have any barnyards?

o No → Please proceed to question 6.

o Yes → 5a. Have any barnyard runoff controls (roof runoff control, diversion of clean water from entering barnyard, and control of runoff from barnyard areas) been implemented?

o No → Please proceed to question 6.

o Yes → 5b. Indicate what kind of runoff control practices have been implemented, the date they were built, whether any county, state or federal government funds were used to construct them, and the certified engineer/company who designed/built the practice(s) (if known).

NOTE: For barnyard runoff controls, if the controls were not funded with government funds, use the Chesapeake Bay Program Resource Improvement Practices (RI) Appendix H RI-16 Barnyard Clean Water Diversion Example Checklist to verify if the structure meets the definition of barnyard runoff controls. If the runoff control practice does not meet all applicable visual indicators, do not count it as an implemented practice.

Runoff Control Practice	Is this practice implemented?	Date Constructed (Month/ Year)	Were county, state or federal funds used to construct the practice?	Certified engineer/company?
Roof runoff structures (gutters, downspouts, outlets)	o No o Yes		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes Name: _____
Concrete barnyards	o No o Yes		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes Name: _____
Curbs	o No o Yes		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes Name: _____
Collection system and/or pumps	o No o Yes		o No o Yes, county funds o Yes, state funds o Yes, federal funds Source of funds if known* _____	o No o Yes Name: _____
Barnyard runoff filter strip	o No o Yes		o No o Yes, county funds o Yes, state funds o Yes, federal funds	o No o Yes Name: _____

			Source of funds if known*	
			_____	

*Sources of funds could be Growing Greener, EQIP, Chesapeake Bay, PennVest, REAP, Section 319, NFWF, etc.

    5c. For all barnyard runoff controls which are not funded using government funds, all visual indicators and the definition provided by CBP RI-16 (Barnyard Clean Water Diversion) have been met.

    o No   o Yes

6. Does the operator have any Agricultural Erosion & Sedimentation Control Plans (E&S Plans) or Conservation Plans for the farming operations?

    o No →   Please proceed to question 7.

    o Yes →   6a. For each plan that the operator has, indicate the type of plan, when it was written or last updated, whether any federal government funds were used to develop the plan, and the acres of each land type covered by the plan.

NOTE: Use the PADEP Agricultural Erosion and Sediment (Ag E&S) Control Plan Administrative Review Guide (i.e., checklist) to determine whether operator's E&S Plan meets the definition of an E&S Plan. If it does not meet the definition of an E&S Plan, do not count it as such.

Plan Type	Month/Year Written or Updated	Were federal funds used to develop plan?	Type and Number of Acres Covered by Plan
o E&S Plan o NRCS Conservation Plan		o No o Yes	Row Crops _____ ac Hay _____ ac Pasture _____ ac Barnyard* _____ ac
o E&S Plan o NRCS Conservation Plan		o No o Yes	Row Crops _____ ac Hay _____ ac Pasture _____ ac Barnyard* _____ ac
o E&S Plan o NRCS Conservation Plan		o No o Yes	Row Crops _____ ac Hay _____ ac Pasture _____ ac Barnyard* _____ ac
o E&S Plan o NRCS Conservation Plan		o No o Yes	Row Crops _____ ac Hay _____ ac Pasture _____ ac Barnyard* _____ ac

*This will typically be in the tenths of an acre

6b. Were your plans written by a qualified individual? _____ (Name)

6c. From whom or where did the operator get information to assist in preparing the plan(s)? (select all that apply)

o Conservation District one-on-one assistance

o Conservation District workshop

o USDA NRCS

o Penn State Extension

o Private sector/certified planner

o Certified Crop Advisor

o None

o Other (please specify): _____

7. Did the operator practice no till or minimum till in calendar year 2015?

    o No →   Please proceed to question 8.

    o Yes →   **7a.** Indicate how many acres meet the following amounts of residue left in the field at the time of planting:

NOTE: Use the conservation tillage visual guidance document to make determinations on amount of residue.

Amount of Residue	Acres
60% or greater	
30% or greater but less than 60%	

7b. How many of the operator's acres have been in continuous no till for the last five years?

_____ acres

7c. Were any county, state or federal government funds used to implement the tillage practice?

    o County funds   o State funds   o Federal funds

What were the source of funds used, if known?_____

Example. Growing Greener, EQIP, Chesapeake Bay, PennVest, REAP, Section 319, NFWF, etc.

8. Did the operator plant cover crops in calendar year 2015?

    o No →   Please proceed to question 9.

    o Yes →   **8a.** Indicate what species were planted, the date they were planted, how many acres of each, whether they received a nutrient application, and whether the operator harvested them:

Species	Date of Planting (Month)	Acres Planted	Nutrient Application?		Harvesting?
Rye			o No o Fall o Yes o Spring		o No o Yes
Wheat			o No o Fall o Yes o Spring		o No o Yes
Barley			o No o Fall		o No

			o Yes o Spring	o Yes
Oats			o No o Fall	o No
			o Yes o Spring	o Yes
Annual Ryegrass			o No o Fall	o No
			o Yes o Spring	o Yes
Annual Legumes			o No o Fall	o No
			o Yes o Spring	o Yes
Triticale			o No o Fall	o No
			o Yes o Spring	o Yes
Mixture (specify: _____ _____ _____)			o No o Fall o Yes o Spring	o No o Yes
Other (specify: _____ _____)			o No o Fall o Yes o Spring	o No o Yes

8b. Were any county, state or federal government funds used to implement the cover crops?

o No

o Yes → o County funds   o State funds   o Federal funds

What were the source of funds used, if known?_____

Example. Growing Greener, EQIP, Chesapeake Bay, PennVest, REAP, Section 319, NFWF, etc.

9. Is there any stream bank fencing on land that is part of the operator's farming operation?

    o No →   Please proceed to question 10.

    o Yes →   9a. How many linear feet is the stream bank fencing? (If fencing is on both sides of the stream, include each side as part of this total) _____ feet

NOTE: For stream bank fencing, if the fencing was not funded with government funds, use the Chesapeake Bay Program Resource Improvement Practices (RI) Appendix H RI-4a, 4b, 5, 6 Watercourse Access Control Example Checklist to verify if the fencing meets the definition. If it does not meet all applicable visual indicators, do not count it as stream bank fencing.

9b. What is the average distance from the top of stream bank to the fence? _____ feet

9c. Were any county, state or federal government funds used to construct this fencing?

     o No

     o Yes → o County funds   o State funds   o Federal funds

     How many linear feet of stream bank fencing was funded using these funds? _____ feet

     What were the source of funds used, if known?_____

     Example. Growing Greener, EQIP, Chesapeake Bay, PennVest, REAP, Section 319, NFWF, etc.

9d. What month/year(s) was the stream bank fencing installed? _____

9e. Is the area inside the fence predominantly in grass, or in trees and/or shrubs?

     o Grass

     o Trees and/or shrubs

9e. Was the area between the fence and stream grazed after the fence was installed?

     o No

     o Yes → How often was the area grazed during the year?

         o Continuous

         o One a year (length of time _____)

         o Twice a year (length of time _____)

         o Other _____

9e. For all stream bank fencing which is not funded using government funds, all visual indicators and the definitions provided by CBP RI-4a, 4b, 5, 6 (Watercourse Access Control) as applicable have been met.

o No   o Yes

10. Are there streamside riparian buffers on land that is part of the operator's farming operation?

    o No →   Please proceed to question 11.

    o Yes →   10a. How many linear feet is the buffer? _____ feet

NOTE: For grass riparian buffers, if the buffer was not funded with government funds, use the Chesapeake Bay Program Resource Improvement Practices (RI) Appendix H RI-7,8 Grass Nutrient Exclusion Area or Buffer on Watercourse Example Checklist to verify if the buffer meets the definition of a grass riparian buffer For unfunded forest riparian buffers, use RI-9,10 Forest Exclusion Area or Buffer on Watercourse Example Checklist. If the practice does not meet all applicable visual indicators, do not count it as a riparian buffer.

10b. What is the average width of the buffer from top of stream bank? _____ feet

10c. What month/year(s) was the riparian buffer(s) installed? _____

10d. Is the riparian buffer in grass, or in trees and/or shrubs?

    o Grass

    o Trees and/or shrubs

10e. What was the prior land use in the buffer?

    o Pasture

    o Cropland

10f. Were any county, state or federal government funds used to install the buffer?

    o No

    o Yes → o County funds   o State funds   o Federal funds

    How many acres of buffer was funded using these funds? _____ acres

    What were the source of funds used, if known?_____

    Example. CREP, CRP, Growing Greener, EQIP, Chesapeake Bay, PennVest, REAP, Section 319, NFWF, etc.

10g. For all buffers which were not funded using government funds, all visual indicators and the definitions provided by CBP RI-7,8 (Grass Buffers) or RI-9,10 (Forest Buffers) as applicable have been met.

o No   o Yes

11. Excluding any riparian buffers identified in the answer to question 10, has the operator retired any cropland from his farming operation to permanent vegetation such as perennial grasses, trees or shrubs?

    o No

    o Yes →   11a. Indicate what year the operator retired the cropland, how many acres have been retired, and whether trees and/or shrubs are growing in the retired acres.

Year	Acres	Are trees and/or shrubs growing in the retired acres?
		o Yes o No
		o Yes o No
		o Yes o No

11b. Were any county, state or federal government funds used to retire the acreage?

    o No

    o Yes → o County funds   o State funds   o Federal funds

    How many acres of retired cropland was funded using these funds? _____ acres

    What were the source of funds used, if known?_____

    Example. CRP, Growing Greener, EQIP, Chesapeake Bay, PennVest, REAP, Section 319, NFWF, etc.

Attachment 2. Tetra Tech Technical Memorandum November 21, 2016
TECHNICAL MEMORANDUM

Date: November 21, 2016
To: Mark Dubin, Chesapeake Bay Program Office
From: Steven A. Dressing, Tetra Tech Inc., Fairfax, VA
Jon B. Harcum, Tetra Tech, Inc., Clemson, SC
Subject: Review of Royer, M., J. Shortle, and A. Cook. 2016. *An Analysis of the Pennsylvania Farm Conservation Practices Inventory for Purposes of Reporting Practices to the Chesapeake Bay Program- Preliminary Draft for Discussion November 18, 2016*. Agriculture and Environment Center Environment and Natural Resources Institute, Penn State University. Prepared for the Pennsylvania Department of Environmental Protection.

This is an addendum to review comments Tetra Tech (Tt) provided in *Assessment of Penn State University Survey of Farms in Pennsylvania, DRAFT* (Tetra Tech, November 15, 2016). That review was based on materials and information provided by Matt Royer prior to completion of the report reviewed here.

p. 9: *Because the data on riparian buffers reveals a statistically significant over reporting, adjustment of the numbers downward using the mean is warranted to account for this over reporting. This would adjust the total of 9,013 reported acres to 6,770 reported acres, with corresponding adjustments to the buffer categories reported based on width and vegetation.*

It would be beneficial here to go through the details of how this calculation was performed.

p. 9-11: The data for Figures 5-13 should also be presented in tabular form so readers can see exactly what the 95% confidence intervals are. While the figures are fine, tables should be included to summarize these data and demonstrate how the adjustment factors [see last comment] are developed.

p. 12: *While statistical analysis of the aggregate dataset using the subsample developed through the verification farm visits allows us to conclude the farm survey results are accurate, we note that in their assessment report of our study, Tetra Tech recommends additional analysis to determine county-to-county variability of accuracy. In response to this recommendation, we have attempted some preliminary county based analysis, but have found that for the vast majority of practices in the vast majority of counties, the sample size is too small to make any statistically significant conclusions. Because of this limitation, we plan on grouping counties by river basin or subriver basin to provide a large enough sample size for statistical analysis and still explore whether geographic variability exists. If the analysis reveals such variability, we can account for that with appropriate adjustments in the data reported.*

We concur with this approach.

p. 12: *However, assuming our further analysis reveals no regional variability, we believe our existing analysis of the aggregate data supports reporting of the cumulative data on the relevant conservation practices reported in the 6,782 survey returns. To address and account for the most accurate reporting for credit in the Bay model, we apply an appropriate factor to address under reporting and over reporting, as also recommended in the Tetra Tech report. This is most appropriately accomplished by taking the mean from the 95% confidence intervals developed for each practice. With this adjustment, the cumulative practices to be reported are summarized in Table 2.*

We concur with this approach, but recommend that the report document the adjustment factors as a table in the report.

Attachment 3: Tetra Tech Technical Memorandum December 6, 2016
TECHNICAL MEMORANDUM

Date: December 6, 2016
To: Mark Dubin, Chesapeake Bay Program Office
From: Steven A. Dressing, Tetra Tech Inc., Fairfax, VA
                  Jon B. Harcum, Tetra Tech, Inc., Clemson, SC
Subject: Review of Royer, M., J. Shortle, and A. Cook. 2016. *An Analysis of the Pennsylvania Farm Conservation Practices Inventory for Purposes of Reporting Practices to the Chesapeake Bay Program- Revised Draft for Discussion and Decision at December 15, 2016 Chesapeake Bay Program Ag Workgroup Meeting December 1, 2016*. Agriculture and Environment Center Environment and Natural Resources Institute, Penn State University. Prepared for the Pennsylvania Department of Environmental Protection.

This is an addendum to review comments Tetra Tech (Tt) provided in *Technical Memorandum Review of Royer, M., J. Shortle, and A. Cook. 2016. An Analysis of the Pennsylvania Farm Conservation Practices Inventory for Purposes of Reporting Practices to the Chesapeake Bay Program- Preliminary Draft for Discussion November 18,* (Tetra Tech, November 21, 2016). Matt Royer and colleagues revised the report in response to comments from Tt and others.

p. 1: Tt agrees with this approach: *In order to ensure the numbers provided to the Commonwealth for reporting to the Chesapeake Bay model eliminate any potential for over reporting, we recommend applying our statistical analysis to adjust only for systematic over reporting of riparian buffers, and not for the other practices where systematic under reporting was evident*.

p. 8: Tt concurs with the reporting of confidence intervals as stated here: *For all results of practices reported cumulatively in Table 1, means and 95% confidence intervals were developed*.

Tt recommends explaining the calculation of the mean and confidence intervals in greater detail to benefit those applying the method in the future. See suggested example below under comments on p. 9.

p. 9: Tt was able to replicate the adjustment for riparian buffers based on the following explanation of adjustments, but found that the language regarding calculation of the confidence intervals was incomplete. Still, Tt was also able to replicate the calculation of lower and upper 95% confidence bounds.

Because the data on riparian buffers reveals a statistically significant over reporting, adjustment of the numbers downward using the mean is warranted to account for this over reporting. This would adjust the total of 9,013 reported acres to 6,770 reported acres, with corresponding adjustments to the buffer categories reported based on width and vegetation. These

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adjustments were calculated as follows: reported value – (mean deviation per farm)n, where n = total number of farms with survey returns (6,782).

Tt strongly recommends that PSU provide an example calculation in an appendix for future reference. Using the reported acres from p. 9 and the sample statistics for privately-funded riparian buffers on p. 87, Tt performed the following calculations which could be used as the example in the appendix: NOTE: Differences are due to rounded values Tt used as input.

Reported Acres: 9,013 (for N = 6,782) (from p. 9 of report)

Verification Data (for n=711) (from p. 87 of report)

Mean Difference (reported-verified): 0.3308

Std. Err. of Difference: 0.1462

Lower 95% Confidence Limit of Difference: 0.0438
    0.3308-1.95996*0.1462 = 0.0443 (you had 0.438)

Upper 95% Confidence Limit of Difference: 0.6179
0.3308+1.95996*0.1462 = 0.6173 (you had 0.6179)

Adjusted Acres (for N=6,782)
    = 9,013-0.3308*6,782 = 6,770 (Mean)

    = 9,013-0.0438*6,782 = 8,716 (Upper 95% CL)

    = 9,013-0.6179*6,782 = 4,823 (Lower 95% CL)

p. 14-15: The regional variability shown in Figures 14-21 is greater than the aggregate variability. The greater magnitudes of mean differences and confidence limits shown in Figures 14-21 indicate that the accuracy of county-level data will be less than the accuracy of aggregate data. Tt recommends careful consideration of diminished county level accuracy when applying the survey data to the Bay model. As has been done with other model input, apportioning aggregate data to the various counties using an algorithm based on county size or similar approach may result in many BMPs being disproportionately allocated to wrong counties. However, direct use of the raw data reported by farmers as recommended by PSU (with the exception of riparian buffers), will have not have that issue. For any approach used, however, Tt concurs with PSU's recommendation that the aggregate totals be those reported by the farmers, with the exception that the total for riparian buffers will be the downward-adjusted total. It should also be noted that, as stated in the PSU report, survey results will not be extrapolated to farms that did not complete the survey, likely resulting in low estimates of BMP implementation in all counties.

p. 17: Tt concurs with the following which is also stated on p. 1: *However, in order to ensure the numbers provided to the Commonwealth for reporting to the Chesapeake Bay model eliminate all possible potential for over reporting, we recommend applying our statistical analysis to adjust only for systematic over reporting of riparian buffers, and not adjusting numbers for the other practices where systematic under reporting was evident.*