To:	Mark Dubin, Senior Agricultural Advisor, University of Maryland Extension, College of Agriculture and Natural Resources, U.S. EPA Chesapeake Bay Program Office
From:	Jon Harcum, Principal Engineer/Hydrologist, Tetra Tech, Inc.
Date:	August 11, 2023
Subject:	CBP TO 08 Review of PADEP Non-Intrusive BMP Verification Standard of Procedure – Follow up

Tetra Tech has been requested to support the Chesapeake Bay Program (CBP) Partnership's Agriculture Workgroup (AgWG) by conducting an independent technical review of a new best management practice (BMP) verification method proposed by the Pennsylvania Department of Environmental Protection (PADEP).

The attached memorandum captures the assessment conducted on the PADEP document provided on July 17, 2023. The evaluation yielded nine elements outlined within the *Analysis, Notes, and Recommendations* section.

Subsequently, a modified version of the document, dated August 10, 2023, was provided. A comparison was made between this revised document and the nine elements highlighted in the attached memorandum. The results are as follows:

- Items #1 and 4 encompassed comments and necessitated no alterations to the document.

- The revised document appropriately addresses comments highlighted in items #2, 3, 5, 6, 7, 8, and 9.

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To:	Mark Dubin, Senior Agricultural Advisor, University of Maryland Extension, College of Agriculture and Natural Resources, U.S. EPA Chesapeake Bay Program Office
From:	Jon Harcum, Principal Engineer/Hydrologist, Tetra Tech, Inc.
Date:	July 26, 2023, revised July 28, 2023
Subject:	CBP TO 08 Review of PADEP Non-Intrusive BMP Verification Standard of Procedure

Introduction

Tetra Tech has been requested to support the Chesapeake Bay Program (CBP) Partnership's Agriculture Workgroup (AgWG) by conducting an independent technical review of a new best management practice (BMP) verification method proposed by the Pennsylvania Department of Environmental Protection (PADEP). This evaluation aims to assess the PADEP proposal in light of previously developed and CBP Partnership-approved guidance and technical review documents. Among these documents is the "*Recommendation Report for the Establishment of Uniform Evaluation Standards for Application of Remote Sensing to Identify and Inventory Agricultural Conservation Practices for the Chesapeake Bay Program Partnership's Watershed Model*" (CBP 2017). The documentation of the PADEP proposal was made available to the AgWG and subsequently to Tetra Tech on July 17, 2023, and the supporting presentation materials were made available on July 20, 2023. Tetra Tech prepared and distributed a draft technical review to involved parties and met with those parties on July 27, 2023. This meeting was used to inform this revised memorandum.

Findings

The report "*Non-Intrusive BMP Verification Standard of Procedure*" presents a methodology for verifying the functionality of agricultural conservation practices based on non-intrusive remotely sensed images and roadside observations. PADEP is requesting the AgWG to approve the methodology described in the report. The U.S. Environmental Protection Agency (EPA) contracted Tetra Tech to conduct an independent technical review of the alternative method and provide suggestions for improving the report's accessibility to the Chesapeake Bay partnership for consideration as a new approved alternative BMP verification methodology.

The *Report Summary* section of this memorandum is a review of the PADEP report provided to the CBP AgWG for their July 20, 2023, meeting. The *Analysis, Notes, and Recommendations* section of this memorandum provides key aspects and additional details that inform this memorandum.

Overall, the authors of the report and PADEP are commended for developing and documenting a novel approach for identifying and verifying targeted types of BMPs. However, there are areas where additional information is needed, and further clarification is warranted to complete this evaluation.

The report documents the methodology used, and the category and number of Resource Improvement (RI) BMPs verified via remotely sensed images and public roadway observations. Ten percent of the total number of verified RI BMPs were re-evaluated as a control dataset using traditional on-site inspection methods resulting in no classification changes. Nevertheless, the report did not include metrics for remote sensing accuracy and completeness at the RI level to judge the overall suitability of the procedure. Since the RIs range from cultural practices (exclusions and buffers) to engineered structures (barnyard clean water diversions), further information at the RI level is needed to complete an evaluation of the report even though the report has stated that the results will not be extrapolated. Further, the number of sites randomly selected for traditional on-site inspections should be reported by RI level.

It is expected that different members of the AgWG have different experiences when considering the merits of remotely sensed images and road-side observations across the range of RI types considered in the report. Therefore, there are sections of the report where additional detail is warranted to improve report clarity and accessibility for the Chesapeake Bay partnership. The areas for improvement encompass discussions on staff responsibilities for road-side observations, screening procedures used in Step 1 (Locate) to exclude sites that are unlikely to be visible from a public road, age of the aerial imagery used, use of the desktop platform for determining specific information, and more insights into how the Survey 123 Online Data Form is used to document visual indicators. To address these issues effectively, it is expected that RI-specific information and distinctions between different types of RIs where applicable would be provided.

Please see the *Analysis, Notes, and Recommendations* section of this memorandum for additional information.

Report Summary

The report "*Non-Intrusive BMP Verification Standard of Procedure*" presents a methodology for verifying the functionality of agricultural conservation practices based on non-intrusive remotely sensed images and roadside observations. The procedure uses publicly accessible data, remote imagery interpretation, historical documentation, and project staff observations from public roadways. The proposed methodology was applied to select agricultural operations located in Clinton, Potter, Lackawanna, Luzerne, and Susquehanna counties in Pennsylvania, but could be more broadly applied.

The procedure was limited to the following RI practices:

- RI-7 Grass Nutrient Exclusion Area on Watercourse
- RI-8 Grass Buffer on Watercourse
- RI-9 Forest Nutrient Exclusion Area on Watercourse
- RI-10 Forest Buffer on Watercourse
- RI-16 Barnyard Clean Water Diversion
- RI-18 Watering Trough

Training Guidelines. The report describes training and qualifications for two groups of professionals involved in the verification procedure. Group 1 professionals should have on-the-job training or attended Natural Resources Conservation Service (NRCS) trainings related to conservation planning and nutrient management. This group relies on their knowledge of NRCS standards and specifications to verify BMPs. Group 2 professionals undergo specific training

activities[1] and on-the-job training. Responsibilities include data entry, verification of priority practices, and completion of checklists during site visits.

Methodology/Procedure. The procedure uses a five-step process.
- **Step 1–Locate** involves locating potential BMPs by using aerial desktop reviews and government agency documents. The Aerial Desktop Review Platform, which includes aerial imagery and mapping portals, aids in identifying specific practice types on the landscape.
- **Step 2–Record** focuses on recording potential practices by placing pins on the Aerial Desktop Review Platform at potential practice locations. The data collected includes practice type, municipality, and associated practice notes.
- **Step 3–Verify** entails field verification, where data recorded in the Aerial Desktop Review Platform are exported as an Excel sheet to create driving routes. Qualified professionals visit all exported sites from the closest public roadway and collect BMP practice information using Survey123 Online Data Forms. The procedure states that "if the practice cannot be seen from the closest public roadway, that practice cannot be verified and cannot be reported as an implemented and verified practice unless a landowner interview occurs, and direct onsite access is provided."
- **Step 4–Report** involves reporting the data by submitting completed Data Forms through the Survey123 application to the online ArcGIS Hub Site. The data are downloaded, stored in an external Excel-oriented database, and entered into Pennsylvania's BMP collection database, Practice Keeper.
- **Step 5–Review** is the review phase where qualified professionals review and approve the entered BMP instances in Practice Keeper, ensuring accuracy and avoiding duplication of records.

Aerial Desktop Review. Additional notes in the report about the desktop review include the following:
- The Aerial Desktop Review Platform included a 35-foot buffer mapped on all waterways enabling users to identify buffer widths less than 35 without desktop measuring.
- Implementation dates were identified visually with historical imagery and updated with landowner information when available. Practices were assigned an implementation date of the date a practice was visited if a date could not be determined from historical imagery or landowner information.
- **Grass Nutrient Exclusion Area on Watercourse (RI-7) and Grass Buffer on Watercourse (RI-8)**. The report indicates that both practices are identified "along a stream or aquatic feature that does not display disturbance from livestock or machinery and does not contain more than 50% canopy cover." The desktop tool is used to determine whether the buffer is between 10 and 34 feet or more than 35 feet in width.
- **Forest Nutrient Exclusion Area on Watercourse (RI-9) and Forest Buffer on Watercourse (RI-10)**. The report indicates that practices are identified "along a stream or aquatic feature that contains a canopy cover greater than 50%. The vegetation within this buffer type consists of woody trees and shrubs that are naturally regenerated or planted."
- **Barnyard Clean Water Diversion (RI-16)**. The report states that "due to the nature of this practice and limitations on consistent indication or poor aerial image resolutions, barn structures were identified and visited to complete non-intrusive field verification."

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[1] The report states that the pilot program adhered to existing agricultural training programs in Pennsylvania including training modules at the Pennsylvania Clean Water Academy remote learning website.

- **Watering Trough (RI-18)**. The report states "due to the nature of this practice and limitations on consistent indication or poor aerial image resolution, pasture and grazing systems were identified and used to" inform water trough systems locations to visit to complete non-intrusive field verification.

A total of 810 RI BMPs was verified using the reported procedure. Ten percent (81) of the total number of RI BMPs were randomly selected and re-evaluated as a control dataset using traditional means of on-site inspections. Mr. Glace, of the Larson Design Group (LDG), indicated in his presentation that there were no changes in the BMP classification.

The report states that the procedure "can be completed in approximately 25% of the time needed for traditional inspections, but it only allows for about 75% visibility and verification of the BMPs compared to traditional [on-site] inspections."

Additionally, the report includes an example graphic of the Survey 123 Online Data form for *Riparian Forest Buffer*.

Analysis, Notes, and Recommendations

1. The authors of the report and PADEP are commended for developing a novel approach for identifying and verifying targeted types of BMPs. It is acknowledged that if this approach is approved by the AgWG, the approach could be adopted and customized to other jurisdictions in the Chesapeake Bay watershed.

2. The report is commended for appropriately outlining staff training requirements; however, the referenced online resources were not available for review. As a result, it is unclear from the report how traditional on-site verification procedures, the focus of the online training videos, are translated to non-intrusive remotely sensed images and road-side observations for each visual indicator associated with the various RI BMPs. In a follow up discussion with the report authors, it was indicated that road-side observations are made by the more experienced, Group 1 professionals. The report should be updated to clearly indicate the staff responsible for 'making the call' on the visual indicators during road-side observations are the more experienced, Group 1 professionals.

3. In Step 1 (Locate), was there any screening to remove sites that were unlikely to be visible from a public road to promote Step 3 (Verify) efficiencies (e.g., distance from the public road, visual barriers regardless of distance from a road)? If so, this information should be included in the report for each evaluated RI BMP. Where appropriate, numerical values should be included (e.g., "structures more than ## meters were excluded from consideration") to improve report accessibility.

4. In Step 5 (Review), the report is commended for including a step to ensure that RI BMPs passing through Steps 1-4 are not duplicated in the Practice Keeper system.

5. During his presentation to the AgWG, Mr. Glace highlighted that aerial imagery could often help determine the age of a particular practice. It is suggested that the age range of the aerial imagery considered in the evaluation be mentioned in the report. Also, include information about the most recent aerial imagery available, considering variations exist between counties.

6. It is presumed that the length of exclusion areas and buffers was determined with tools in the desktop platform. In Step 2 (Record), it is recommended that the report include a description of the approach used to determine these lengths.

7. The Survey 123 Online Data Form depicted in the report for riparian buffers did not include a data entry item for RI-9,10 Visual Indicator #3, *Overland/sheet flow through buffer is maximized (no concentrated flow)*. In a follow up discussion with the report authors, it was indicated that additional data entry items would appear. Nevertheless, it is recommended that the report be updated to demonstrate that all visual indicators were included in the Survey 123 Online Data Form and to clarify how the data entry was completed for visual indicators that were not visible from road-side observations.

8. The report states that about 75% of the BMPs could be verified but the report did not include metrics for remote sensing accuracy and completeness at the RI level to judge the overall suitability of the procedure. Since the RIs range from cultural practices (exclusions and buffers) to engineered structures (barnyard clean water diversions), further information at the RI level is needed to complete an evaluation of the report even though the report has stated that the results will not be extrapolated. It is recommended that the report be expanded to include tables with RI-specific information that identifies: the number of BMPs identified during Step 1; the number of BMPs from Step 1 verified in Step 3; the number of BMPs found in Step 3 that were not identified in Step 1; hit rate (HR); the critical success index (CSI); the false alarm ratio (FAR); and confidence intervals for HR, CSI, and FAR (CBP 2017, Tetra Tech 2016).

9. The authors of the report and PADEP are commended for randomly selecting 10% of the BMP sites for traditional on-site inspections. The report indicates 100% agreement between the non-intrusive remotely sensed images and road-side observations and the on-site inspections although some additional data elements were completed during the on-site inspections. Please report the number of on-site inspections at the RI-level.

References

CBP (Chesapeake Bay Program). 2017. *Recommendation Report for the Establishment of Uniform Evaluation Standards for Application of Remote Sensing to Identify and Inventory Agricultural Conservation Practices for the Chesapeake Bay Program Partnership's Watershed Model*. https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/recommendation_report_draft_final.pdf. Accessed: 7/18/2023.

Tetra Tech. 2016. Assessment of NRCS Remote Sensing Pilot in Potomac River Basin of Pennsylvania. https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/assessment_of_pilot_remote_sensing_12-13-2016.pdf. Accessed: 7/18/2023.

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