
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 VA DCR Virginia Tillage/Residue Survey – Using an Alternative Approach for Verification – 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 Virginia Department of Conservation and Recreation (VADCR).

The attached memorandum captures the assessment conducted on the VADCR document's July 20, 2023, version. The evaluation yielded eight elements outlined within the *Analysis, Notes, and Recommendations* section.

Subsequently, a modified version of the document, dated July 26, 2023 (and later updated “for Approval on August 17, 2023”), was provided by VADCR. A comparison was made between this revised document and the eight elements highlighted in the attached memorandum. The results are as follows:

- Items #2, 3, and 7 encompassed comments and necessitated no alterations to the document.
- VADCR's revised document appropriately addresses comments highlighted in items #1, 4, 5, 6, and 8.

Attachment 1



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 VA DCR Virginia Tillage/Residue Survey – Using an Alternative Approach for Verification

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 Virginia Department of Conservation and Recreation (VADCR). This evaluation aims to assess the VADCR 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 Roadside Transect Surveys to Identify and Inventory Agricultural Conservation Practices for the Chesapeake Bay Program Partnership's Watershed Model"* (CBP 2017). The documentation of the VADCR proposal was shared with the AgWG and subsequently provided to Tetra Tech on July 17, 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

In the Virginia Department of Conservation and Recreation (VADCR) document *"Virginia Tillage/Residue Survey – Using an Alternative Approach for Verification,"* VADCR is requesting the CBP Agriculture Workgroup (AgWG) to "review the methodology described in [their] document and approve for submittal of the 2022 survey results for use in the Bay Model." The US EPA contracted Tetra Tech to conduct an independent technical review of the alternative method used to verify their transect survey and to provide suggestions for improving the report's accessibility to the Chesapeake Bay partnership for consideration as a new approved alternative BMP verification methodology.

The VADCR report documents the methodology used, challenges encountered, and accuracies achieved in a manner that is transparent. The report documented an overall accuracy of 84% between photo verification and 'in-field' ground truthing classifications at 95 sites with no sites more than 'one category' different, suggesting that photo verification is a reasonable substitute for revisiting sites for in-field verification. The report also documented an overall accuracy of 85% between survey team classifications and photo verification at 1,561 sites (11.5% of 13,600 sites surveyed).

The remainder of this report is divided into two sections plus references. The *Report Summary* section is a review of the VADCR report provided to the CBP AgWG for their July 20, 2023, meeting, and the *Analysis, Notes, and Recommendations* section provides key aspects of the report that inform the findings and provides suggestions to improve the report clarity and accessibility for the Chesapeake Bay Program Partnership.

Report Summary

VADCR conducted tillage transect surveys during 2015 and 2022 in the Chesapeake Bay Watershed of the Commonwealth to update the data reported for agricultural conservation practice implementation, known also as Best Management Practices (BMPs). The survey, originally planned for 2021, but delayed due to COVID-19, was conducted in 2022 using the roadside transect survey method. The report notes that the tillage data are not currently verified during the intervening years between cycles.

The survey teams consisted of professionals from the agricultural community, trained by VADCR in residue evaluation methods. The survey units were based on jurisdictions with significant crop land acreages to conform to the minimum number of observation points required for transect surveys. In 2022, the routes were determined by the survey teams or provided by VADCR using ArcGIS Pro. The data collected during the 2022 survey were synced with ArcGIS Online, enabling real-time monitoring of survey progress and verifying observation points.

To streamline the 2022 survey verification process and avoid separate in-person QA/QC visits to survey points for verification, an alternative approach using digital imagery was implemented for the 2022 survey. Approximately 13,600 points were surveyed, and more than 4,000 digital images were taken and uploaded for the 2022 survey through a mobile data collection application called Quick Capture. Quick Capture allowed for the capture of point locations and associated images to be used for a separate verification review.

The verification process involved reviewing the images taken by surveyors to determine residue coverage independently of the in-field survey team. In the initial attempt, approximately one-half of the images were randomly sampled with the intent of reviewing at least 10 percent of the 13,600 surveyed points. Multiple reviewers classified 1,760 photos, resulting in an overall accuracy of 64%. The accuracy rate prompted a second approach. Review procedures were updated by removing images that were not of sufficient quality to estimate residue coverage and the remaining images were classified by a single independent reviewer. The final review was based on 1,561 photographs and had an overall accuracy of 85%.

A subset of survey sites (189 sites) that were initially surveyed using the new procedure with obtaining digital images, was revisited in person to evaluate the effectiveness of digital imagery interpretation. The overall accuracy between the original classification performed by the survey teams and the revisiting surveyor was 63%. The report attributes this outcome to potentially “the small sample size or, alternatively, to the specific, smaller area that was verified in person not having as high of an original accuracy compared to the entire area that was surveyed.” In addition, the revisitation results for 95 sites with associated images out of the 189 total survey sites were compared to the imagery classification. The overall accuracy was 84%.

Analysis, Notes, and Recommendations

1. VADCR is requesting the review and approval of the methodology described in their report for the submission of the 2022 survey results to be used in the Bay Model (pg 16). Tetra Tech's review is contractually limited to the methodology.
2. VADCR is commended for exceeding the 10% threshold identified in the CBP (2017) report by verifying 11.5% of the sites (1,561 out of 13,600) in their revised digital image verification procedure.
3. The report indicated that the initial overall accuracy between survey teams' classification and digital image verification was 64% based on 1,760 sites. DCR is commended for investigating and revising their imagery verification methodology by removing images with insufficient quality and revising the imagery verification process by using one analyst. These changes in procedure resulted in an overall accuracy of 85%.
4. The sample digital images categorized as having insufficient quality appear to be typically due to the oblique angle that the image was taken. It is suggested that the report include recommendations for consistency when obtaining 'in-field' images are possible (e.g., height, angle, shadows, portrait/landscape, orientation to planted crop), or minimally, note in the recommendations that future training will be updated to include more details on desired and consistent images.
5. The report indicated that 189 sites initially surveyed using the new procedure by obtaining digital images, were revisited in person as a control data subset implementing an infield verification method. The overall accuracy in classification between the results from the survey teams and digital image verification was 63%. The rationale for this accuracy is plausible. However, taken collectively with the results from the initial verification, these overall accuracies could also be attributable to variability in ocular calibration (CBP 2017, p 7-8). The passage from CBP (2017) is provided here:

In the past, CTIC had provided guidance on data collection methods and photos of various residue amounts so participants could calibrate their ocular estimates (Chad Watts, CTIC, personal communication, February 21, 2017). Where multiple people conducted the residue surveys, the quality of final results was subject to their ability to maintain this ocular calibration. Even with procedures that included routine verification of ocular estimates with field measurements, it was difficult to maintain acceptable quality assurance/quality control for surveys involving multiple people in multiple places.

It is recommended that VADCR update the report to 1) acknowledge that variances in ocular calibration could also contribute to the observed overall accuracy and 2) include recommendations for maintaining ocular calibration throughout the survey effort for both survey teams and verification teams.

6. Method verifications were made with 189 sites for comparing survey team classifications and 'in-field' ground truthing and 95 sites for comparing photos to 'in-field' ground truthing. It is recommended that the report be updated to clarify that the 95 sites are a subset of the 189 sites where images were taken. This point was made clear in Mr. Blankenship's presentation but was not readily apparent in the report.

7. Should the AgWG vote to accept the alternative BMP verification methodology that this report proposes, VADCR is reminded of the recommendations in the Recommendation report (CBP 2017).
8. The photos included in the appendix are geolocated. Should the location information be removed from the distributed information?

References

CBP (Chesapeake Bay Program). 2017. *Recommendation Report for the Establishment of Uniform Evaluation Standards for Application of Roadside Transect Surveys to Identify and Inventory Agricultural Conservation Practices for the Chesapeake Bay Program Partnership's Watershed Model*. CBP/TRS-317-17. Retrieved from https://www.chesapeakebay.net/documents/Transect_Survey_Recommendations_Report_3-16-17.pdf. Accessed: 7/18/2023.