Increasing Effectiveness and Reducing the Cost of Non-Point Source Best Management Practice Implementation: Is Targeting the Answer?

Summary Description and Workshop Objectives

Targeting best management practice (BMP) implementation to areas of the landscape that produce the majority of the non-point source pollution is essential to achieve pollutant reduction targets given limited funding. The objectives of the proposed 2-day workshop are to:

1) Review effectiveness of existing BMP implementation strategies to improve water quality
2) Review the evidence of effectiveness of targeting to improve water quality outcomes and lower costs (both modelled and measured outcomes), e.g. to what degree can targeting incrementally move the needle and buy more reductions with the same fixed budget
3) Identify the approaches to targeting (conceptually and program implementation) including incentives and barriers
4) What would more effective targeting look like in the Chesapeake Bay? What are the short- and long-term suggestions for how to target in the CBP?
    a. Near and long-term recommendations for improving water quality response to BMPs
    b. What is required from CBP to accomplish this with respect to both policy and modeling

Workshop Justification

As the CBP passes the mid-point assessment, point source discharges will have achieved (or nearly achieved) their final TMDL nitrogen (N) and phosphorus (P) wasteload allocations. Jurisdictions, however, still need to achieve substantial nutrient and sediment reductions from agricultural and urban nonpoint sources. Based on current understanding and modeling, the CBP estimates that agriculture and urban nonpoint sources need to achieve an additional 35 million and 12 million pounds of N reductions, 1.3 and 0.6 million pounds of P reductions, and 941 and 594 million pounds of sediment, respectively to meet TMDL goals. State and local governments are poised to spend hundreds of millions of additional dollars to meet these goals, primarily by installing nonpoint source BMPs.

Thus, BMP implementation stands at the center of CBP efforts to meet TMDL requirements. Yet, water quality monitoring suggests that the link between BMP implementation and load reductions is tenuous at best. In a recent STAC review, Keisman et al (2018) state "current research suggests that the estimated effects of conservation practices have not been linked to water quality improvements in most streams." The CB watershed model estimates substantial reductions in ag loads, but monitoring data suggests little to no change in ag loads between 1992-2012 (Keisman et al 2018). A critical question is why? Potential explanatory factors include inadequate BMP coverage, poor implementation/ maintenance, lag times between implementation and pollutant load reductions, and inability to target BMPs to critical pollutant source areas (Easton et al. 2017). In this workshop we propose to address the last point, BMP targeting.

Many studies have noted that areas of high nutrient loss are site specific and highly localized. If BMPs tend to get applied in lower risk areas rather than targeted to areas where nutrient loads are more likely to originate, nutrient load reduction effectiveness will be overestimated. Many studies suggest that between 5 - 20% of the land area generates 50-90% or more of runoff and nonpoint source loads, particularly for pollutants such as phosphorus and sediment (Heathwaite et al. 2000; White et al. 2009; Qui, 2009; Wagena and Easton, 2018; Rao et al. 2009; Yu et al. 2019). Within fields, nutrient losses may be confined to relatively small areas (Easton et al. 2008), that with the correct targeting and incentives may be easily treated at relatively low cost. Yet few NPS implementation programs have been designed to identify and treat high pollutant loss areas, including those in the Chesapeake Bay watershed. NPS implementation programs typically apply BMPs and other treatment measures based on factors including the willingness of landowners to participate, access to sites, and distribution of financial incentives. In addition, some programs cannot or do not identify and credit treatment of high impact areas. For instance, modeling capacities may not be spatially or analytically refined enough to identify localized areas of high loss and by extension areas that would be critical to target with BMPs.

Numerous studies have found that targeting BMPs to sites with higher pollution potential can improve cost effectiveness of pollution reduction efforts (Khanna et al. 2003; Yang and Weersink 2004; Yang et al. 2005; Giri et al.

2012; Xu et al. 2019). Studies have shown that targeting BMPs or a land retirement payment scheme by flow paths, sub-catchment, soil erodibility, or other land and soil characteristics instead of applying BMPs randomly or uniformly can reduce costs of meeting a given water quality goal (Yang and Weersink 2004). Multiple policy designs could be pursued to better target cost effective nonpoint source reduction investments, each with different strengths and limitations (Ribaudo 2015). In voluntary programs, targeting could be accomplished by more centralized and directed financial assistance payments. Other designs would create decentralized incentives by compensating landowners based not on practice installed but on pounds of nutrients reduced (pay for performance using fixed or variable price mechanisms). Some pilot programs have even sought to pay groups of participants based on changes in ambient outcomes (instream nutrient levels). Given accessible ways to identify localized loss areas, such programs provide incentives to seek out high reduction and low treatment cost options.

Workshop Design

This workshop seeks to provide the CBP with pertinent and timely recommendations about how to structure a BMP targeting program. The overall goal is to inform the development of processes/approaches to identify cost effective selection and placement of BMPs that maximize nutrient reductions of limited funding in the Chesapeake Bay. Questions/Objectives that will be addressed include:

1) To what extent can applying NPS control measures to high loss areas improve water quality outcomes?
2) How NPS programs can be designed to maximize the treatment benefits of NPS control measures by identifying and targeting high loss areas?
3) How does BMP targeting work in a voluntary program?
4) What scale is appropriate to target (sub-field, field, subbasin, specific land uses, geomorphic regions, etc)?
5) What modeling or monitoring changes are needed to improve targeting of NPS BMP investments?
6) What programmatic or policy changes act as a barrier to targeting and how can these barriers be overcome?

Workshop Program: The program will begin with a summary presentation outlining the current CBP modeling and policy tools used to make NPS BMP investments. An introductory presentation will summarize prior research about other watershed BMP programs that employ targeting and that have produced demonstrated reductions in ambient pollutant levels. Other presentations will include discussions of policy, behavioral, regulatory, and implementation options and issues involved in targeting. Workshop participants will develop guidance recommendations for incorporating BMP targeting as a part of WIPs. Substantial time will be devoted to small group discussions to understand the challenges associated with developing BMP targeting plans and to generate/develop ideas for improving the evaluation, consideration, and reporting of BMP performance. Workgroup participants will reconvene to discuss and clarify recommendations to put forward.

The ultimate goal of the workshop is to generate recommendations for increasing NPS reductions and lowering costs of BMP investments. The workshop will also include facilitated discussions about how BMP targeting could be better integrated into watershed modeling and WIP implementation planning (Obj 3). Facilitated discussions will follow that will solicit ideas and recommendations for improving understanding and consideration of BMP targeting in CBP modeling and TMDL implementation.

A workshop is the most appropriate forum for the proposed effort because Objs 3, 5, and 6 are more effectively addressed via a facilitated discussion with invited experts. In order to further facilitate discussion at the workshop and reduce time spent summarizing prior research, we propose developing an initial synthesis to provide background for Objs 1,2, and 4 to be shared with participants prior to the workshop.

Anticipated Workshop Participants: The steering committee (see below) will identify and invite participants that will facilitate the discussion about and development of effective and practical workshop recommendations. Workshop attendees will include CBP staff representing the modeling group and program management, researchers with expertise in targeting and watershed management, and managers and decision makers at state and municipal levels.

Workshop Products: The workshop will produce a report that will provide guidance recommendations for incorporating BMP targeting within NPS policies and management programs. Technical modeling recommendations will be directed toward the CBP Modeling Workgroup. Recommendations will also be made for state and federal Chesapeake Bay Program partners (including the Water Quality Goal Implementation Team, particularly the

Agriculture and Urban Stormwater Workgroups) for programmatic or policy changes with the potential to improve effectiveness and lower costs of achieving NPS controls.

Logistics: The workshop will be conducted over 2 days in the late summer early Fall of 2019 (flexible). Workshop participation will be by invitation only. To facilitate effective discussion, the workshop will be limited to less than 40 people and held in the northern Virginia/Maryland region. The workshop report will be produced within 90 days following the workshop

Budget: Venue: $3,500; Catering $2,000; Travel for invited participants $4,500. Total Requested from STAC: $10,000

Results from Previous Workshops

Stephenson, Easton, and others led a STAC workshop in 2017 on BMP uncertainty. This workshop developed recommendations for improving the consideration of uncertainties about BMP performance in the expert panel process and the CB WSM.

Workshop Steering Committee

Zach Easton (Chair) Biological Systems Engineering, Virginia Tech. Expertise in watershed modeling and model development, BMP performance, and risk assessment. STAC member. Kurt Stephenson (Co-Chair) Agricultural and Applied Economics, Virginia Tech. Expertise in policy analysis and evaluation. STAC Executive Board member. Amy Collick Agriculture, Food and Resource Sciences, UMES. Expertise in agricultural nutrient management and modeling. STAC Member. Patrick Fleming Department of Economics, Franklin and Marshall College. Expertise in behavioral response to NPS policy, and integration of economic data with CBP model. James Martin Davis VADEQ. Virginia Chesapeake Bay Program Manager. Expertise in WIP. Marc Ribaudo USDA-ERS, Retired. Expertise in economic incentives. Former STAC member. Gary Shenk USGS CBP. Lead model developer for the CBP.

References

Easton, Z.M., M.T. Walter, T.S. Steenhuis. 2008. Combined monitoring and modeling indicate the most effective agricultural best management practices. J. Environ. Qual. 37:1798–1809.

Easton, Z.M., D. Scavia, R. Alexander, K. Boomer, P. Kleinman, A. Miller, J. Pizzuto, D. Smith, and C. Welty. 2017. Review of the CBP Phase 6 Watershed Model. STAC Publication Number 17-007, Edgewater, MD. 47 pp.

Giri S., A.P. Nejadhashemi, S.A. Woznicki. 2012. Evaluation of targeting methods for implementation of best management practices in the Saginaw River Watershed. J. Environ. Manag. 103:24–40

Heathwaite, L., A. Sharpley, W. Gburek. 2000. A conceptual approach for integrating phosphorus and nitrogen management at watershed scales. J. Environ. Qual. 29:158-166. doi:10.2134/jeq2000.00472425002900010020x

Keisman, J., J. Blomquist, J.K. Bohlke, J. Davis-Martin, W. Dennison, C. Friedrichs, R. Murphy, S. Phillips, J. Testa, E. Trentacoste, D. Weller. 2018. Integrating recent findings to explain water-quality change: support for the mid-point assessment and beyond. STAC Publication Number 18-005, Edgewater, MD. 27 pp.

Khanna M., W. Yang, R. Farnsworth, H. Önal. 2003. Cost-effective targeting of land retirement to improve water quality with endogenous sediment deposition coefficients. Am J Agric Econ 85(3):538–553

Ribaudo, M. 2015. The limits of voluntary conservation programs. Choices. 30 (2)

Rao, N.S., Z.M. Easton, E.M. Schneiderman, M.S. Zion, D.R. Lee, T.S. Steenhuis. 2009. Distributed modeling of agricultural best management practices to reduce phosphorus loading. J. Environ. Mang. 90: 1385-1395.

Qui, Z. 2009. Assessing critical source areas in watersheds for conservation buffer planning and riparian restoration. Environmental Management (2009) 44:968–980 DOI 10.1007/s00267-009-9380-y

Xu, Y., D. Bosch, M. Wagena, A. Collick, Z.M. Easton. Meeting water quality goals by spatial targeting under climate change. J. Environ. Manage. 1-12. 10.1007/s00267-018-01133-8.

Wagena, M.B., Z.M. Easton. 2018. Conservation practices can help mitigate the impact of climate change. Science of the Total Environ. 635 (2018) 132–143. https://doi.org/ 10.1016/j.scitotenv.2018.04.110

White, M. J., D.E. Storm, PR. Busteed, S. H. Stoodley, S.J. Phillips. 2009. Evaluating nonpoint source critical source area contributions at the watershed scale. J. Environ. Qual. 38:1654-1663. doi:10.2134/jeq2008.0375

Yang W., A. Weersink. 2004. Cost-effective targeting of riparian buffers. Can. J. Agric Econ. 52(1):17–34.