Report to the Governor and the Chairmen of the House Committee on Agriculture, Chesapeake and Natural Resources and the Senate Committee on Agriculture, Conservation and Natural Resources, Pursuant to House Bill 1774 (2017)

Compiled by the Commonwealth Center for Recurrent Flooding Resiliency

December 1st, 2017

Transmittal Letter

December 1, 2017

The Honorable Terence R. McAuliffe
Governor of Virginia

The Honorable Richard H. Stuart, Chairman
Senate Agriculture, Conservation and Natural Resources Committee

The Honorable Daniel W. Marshall III, Chairman
House Agriculture, Chesapeake and Natural Resources Committee

Dear Governor McAuliffe, Senator Stuart and Delegate Marshall,

During its 2017 Session, the General Assembly passed HB1774 to create a stakeholders work group to examine opportunities to improve the administration of the Commonwealth's stormwater management program and the potential treatment and use of water in roadside ditches in rural Tidewater localities. The legislation required the Commonwealth Center for Recurrent Flooding Resiliency (CCRFR) to provide comprehensive analysis in support of the work group's examination, and to report the results to the Governor and the Chairmen of the House Committee on Agriculture, Chesapeake and Natural Resources and the Senate Committee on Agriculture, Conservation and Natural Resources by January 1, 2018**.**

Pursuant to that legislation, attached please find the report of the Commonwealth Center for Recurrent Flooding Resiliency, summarizing the recommendations of the HB1774 Workgroup and the process used to develop them. Also attached is a voluminous set of appendices setting forth CCRFR's and Workgroup members' research and analysis in support of the Workgroup's efforts, as well as analysis provided by Mike Rolband, President of Wetlands Studies and Solutions, Inc., who served as an expert advisor to the group.

The Workgroup had various interests represented, as required by the statute. I had the privilege of facilitating the meetings of this diverse group of engaged and knowledgeable stakeholders, which met throughout the summer and fall of this year. After much hard work in a short period of time, the Workgroup came to consensus on all of its recommendations, with no dissenting votes. This consensus is a testament to the Workgroup members' willingness to collaborate, to commit substantial amounts of their time and attention to this important task, and to consider innovative solutions. As facilitator, I am happy to submit this consensus report to you on behalf of the CCRFR and the HB1774 Workgroup.

Respectfully,

Elizabeth A. Andrews, Director
Virginia Coastal Policy Center, William & Mary Law School
eaandrews@wm.edu, (804) 221-3780

cc: Delegate Keith Hodges

Preface

This report was authored by the Commonwealth Center for Recurrent Flooding Resiliency (CCRFR), a collaborative effort between the Virginia Institute of Marine Science, Old Dominion University, and the College of William & Mary created by Chapter 440 of the 2016 Acts of Assembly.

The mission of the CCRFR is to engage the expertise, resources and intellectual vibrancy of William & Mary and Old Dominion University in support of building resilience to rising waters. The Center serves, advises, and supports Virginia by conducting interdisciplinary studies and providing training, technical and non-technical services, and policy guidance in the area of recurrent flooding resilience to the Commonwealth and its local governments, state agencies, industries and citizens.

Acknowledgements

The Commonwealth Center for Recurrent Flooding Resiliency wishes to thank the members of the HB1774 Workgroup for all of their hard work, diligence and willingness to consider innovative approaches to managing stormwater while protecting the Commonwealth's water quality. In addition, sincere thanks are due to Mike Rolband, President of Wetlands Studies and Solutions, Inc., who tirelessly provided indispensable expert assistance to the CCRFR research team and the members of the Workgroup. Finally, special thanks go to Jamie Huffman, fellow at the Virginia Coastal Policy Center at William & Mary Law School, for her invaluable assistance in drafting Workgroup meeting minutes and compiling this report.

Table of Contents

Executive Summary

This report was required by House Bill 1774 (2017), in which the General Assembly requested that the Commonwealth Center for Recurrent Flooding Resiliency convene a workgroup to study the administration of the Commonwealth's current stormwater management program, as well as the potential treatment and use of water in roadside ditches in rural, Tidewater Virginia localities.

Under the Virginia Stormwater Management Act, the Department of Environmental Quality administers stormwater management requirements for any localities that opt out of becoming a Virginia Stormwater Management Program authority, but only for land disturbances of one acre or more that are covered by the Virginia Pollutant Discharge Elimination System General Permit for Discharges of Stormwater from Construction Activities issued by DEQ. However, in localities that are subject to the Chesapeake Bay Preservation Act, the stormwater management and erosion and sediment control requirements must be applied to all land disturbances of 2,500 square feet or more. This Workgroup was convened and this report was created to propose potential solutions to address rural Tidewater localities' concerns regarding administration of regulatory coverage for land disturbances of between 2,500 square feet and one (1) acre, and to assess potential innovative alternatives for treatment and use of stormwater in these rural Tidewater localities.

Key Findings:

- A nutrient or volume credit trading system for water within roadside ditches in Tidewater Virginia would not be feasible. Such an approach would require the expansion of the current credit trading scheme beyond a single river basin, which is not allowed under current law as it is not protective of local water quality. Further, there is currently little market for nutrient or volume credits in Tidewater Virginia, making this approach impractical.
- At this time, the use of Comprehensive Stormwater Management Plans for land disturbances between 2,500 square feet and one (1) acre is not viewed as providing rural Tidewater localities with an easier to administer option, since they can involve significant investment in time and money to develop.
- Implementing a large-scale program to treat stormwater in ditches in rural Tidewater localities would not achieve a significant reduction in pollutants to assist the Commonwealth in achieving its nonpoint source load allocation under the Chesapeake Bay Total Maximum Daily Load; i.e., the amount of pollutant reduction achieved would not justify the cost of treating all ditches in the ditch network. However, most of the pollutant load in these ditches comes from agricultural land uses, so the Commonwealth could have an interest in seeing targeted BMPs implemented to reduce these pollutants and provide meaningful water quality progress in targeted areas.
- There currently is an extremely low level of development in rural Tidewater localities.

Recommendations:

The Workgroup agreed that all of its recommendations apply to rural Tidewater localities, which it defined as localities within the Northern Neck, Middle Peninsula, and Accomack-Northampton Planning Districts that are eligible to join the Rural Coastal Virginia Community Enhancement Authority established by § 15.2-7600 and are subject to the provisions of the Chesapeake Bay Preservation Act, § 62.1-44.15:67. The Workgroup also noted that, throughout their discussions, they thought of Caroline County as one of the localities that should be covered by these recommendations, and data from Caroline County was used as part of the Workgroup's decision-making process.

- Given the fact that the Chesapeake Bay program is currently reviewing ditch management as an effective stormwater management practice, the Workgroup identified seven possible funding sources that the Governor, General Assembly and others could consider to fund the development of targeted BMPs to reduce agricultural pollutant load in rural Tidewater localities and potentially save money for the Virginia Department of Transportation (VDOT) if private entities improve and assume maintenance of some ditches in VDOT's drainage network. Such possible funding sources include the creation of a subfund for the Stormwater Local Assistance Fund.
- In order to address concerns raised by rural Tidewater localities concerning administration of a stormwater management program, the Workgroup identified the implementation of a tiered approach to the water quantity requirements of the stormwater management program that is based upon the percent of impervious cover in a watershed. Each of the three tiers within this approach would require the application of different water quantity requirements, with varying levels of complexity. This approach may allow rural localities in Tidewater Virginia to implement less complex (yet still protective) water quantity requirements within areas with only a small amount of development and associated impervious cover for development activities disturbing less than one acre. This tiered approach would require increasing levels of protection and regulation with increasing percentage of impervious cover. This approach will also require rural Tidewater localities to develop, by ordinance, watershed maps indicating impervious cover. The Workgroup also noted that a high level of scientific analysis was necessary in order to reach this recommendation, as can be seen in Appendix 11, and a similar level of analysis would be necessary if this proposal were considered for expansion beyond the rural Tidewater localities.
- The Workgroup recommends that both a VSMP/VESCP authority and a Tidewater Virginia locality that has opted out of administering a VSMP program be authorized to require and accept stamped/sealed plans and supporting calculations, as well as required inspection/ monitoring reports, from a licensed professional retained by the applicant in lieu of local plan review and the requirement for a local certified plan reviewer/inspector.
- Finally, the Workgroup also supports further research into expansion of the use of an Agreement in Lieu of a stormwater Plan (ALP) to non-residential sites between 2,500 square feet and an acre.

The Workgroup came to consensus on this report and its recommendations. The representatives associated with Virginia state government (the Department of Forestry, Department of Transportation, Department of Environmental Quality, the Secretary of Natural Resources' Office, and the Chesapeake Bay Commission) noted that they participated in the work of the group and identified no technical concerns, but recused themselves from voting on the recommendations since the report involves potential legislation. Additionally, DEQ noted that the stormwater management program, in general, needs sustainable funding.

HB1774 Workgroup Background and Organization

This report was compiled by the Commonwealth Center for Recurrent Flooding Resiliency (CCRFR) pursuant to House Bill 1774 from the 2017 General Assembly session (Appendix 1), which called for the formation of a stakeholders workgroup to analyze the administration of the Commonwealth's stormwater management program and the potential treatment and use of water in roadside ditches in rural Tidewater localities. Specifically, the language of HB1774 required "that the Commonwealth Center for Recurrent Flooding Resiliency shall convene a work group to examine opportunities to improve stormwater management in rural localities that are located in Tidewater Virginia, as defined in § 62.1-44.15:68 of the Code of Virginia." [1]

The bill further directed that the Virginia Coastal Policy Center at William & Mary Law School facilitate the Workgroup meetings, and that participants would include "representatives of institutions of higher education, state agencies, local governments, private industry, and other groups."[2] The bill provided that the Workgroup was to review and consider the creation of rural development growth areas, the development of a volume credit program, the payment of fees to support regional stormwater Best Management Practices (BMPs), and the allowance of the use of stormwater in highway ditches to generate volume credits.[3] The bill also required the CCRFR to report the results of the Workgroup's analysis to the Governor and the Chairmen of the House Committee on Agriculture, Chesapeake and Natural Resources and the Senate Committee on Agriculture, Conservation and Natural Resources by January 1, 2018.[4]

Background

In 2012, the Virginia General Assembly passed SB407/HB1065, often called the "Integration Bill," which made changes to the CBPA,[5] the Stormwater Management Act,[6] and the Erosion and Sediment Control Law[7] in order to better integrate the three programs.[8] Among other things, the bill required all localities in Virginia to become Virginia Stormwater Management Program (VSMP) authorities and operate VSMPs by July 1, 2014.[9] As that date approached, some rural localities expressed concern that they did not have the resources to administer stormwater management programs. Therefore, Delegate Keith Hodges (R-98th Dist.) patroned a bill in 2014 that allowed localities to opt out of administering a VSMP and have the

---

[1] 2017 Va. Acts Ch. 345.
[2] *Id.*
[3] *Id.*
[4] *Id.*
[5] VA. CODE ANN. § 62.1-44.15:67 (2013).
[6] VA. CODE ANN. § 62.1-44:15:24 (2014).
[7] VA. CODE ANN. § 62.1-44:15:51 (2013).
[8] 2012 Va. Acts 785; 2012 Va. Acts 819.
[9] Va. Code Ann. § 10.1-603.3M (changed to VA. CODE ANN. § 62.1-44.15:27 (2013)) (repealed 2014).

Department of Environmental Quality (DEQ) operate a stormwater management program for them.[10]

In 2015, DEQ formed a Stakeholders Advisory Group to further examine ways to streamline the three programs and make them more consistent. This effort resulted in 2016 legislation combining the Virginia Stormwater Management Act and the Erosion and Sediment Control Law, with a delayed effective date of July 1, 2017.[11] The legislation allowed localities that had opted out of administering a Virginia Stormwater Management Program to continue to opt out and to maintain a separate Erosion & Sediment Control Program. During this effort, some rural localities expressed concern that, although they had opted out of administering a VSMP pursuant to Del. Hodges' 2014 legislation, they still would be required to administer the Commonwealth's stormwater management requirements in two specific instances. The two situations that raised concern from some rural localities have come to be called the "donut holes:"

> 1) Under the Stormwater Management Act, DEQ administers stormwater management requirements for any localities that opt out of becoming a VSMP authority, but only for land disturbances of one acre or more that are covered by the General Virginia Pollutant Discharge Elimination System (VPDES) Permit for Discharges of Stormwater from Construction Activities[12], issued by DEQ.[13] In localities subject to the CBPA, the stormwater management and the erosion and sediment control requirements must be applied to all land disturbances of 2,500 square feet or more. Therefore, with respect to these smaller development sites, the CBPA localities that "opted out" must continue to administer stormwater management and erosion and sediment control requirements.
>
> 2) Pursuant to the Erosion and Sediment Control Law, localities not covered by the CBPA must administer erosion and sediment control requirements for all developments that disturb 10,000 square feet or more, and localities subject to the CBPA must administer erosion and sediment control requirements for all developments that disturb 2,500 square feet or more.[14] In the 2012 Integration Bill, the Erosion and Sediment Control Law was amended to provide that, in lieu of complying with Minimum Standard 19[15] in the Erosion and Sediment Control regulations, the water quantity requirements in the new stormwater management regulations could be applied instead.[16] Thus, if a locality opted out of administering a VSMP pursuant to the 2014 legislation, it must

---

[10] 2014 Va. Acts Ch. 598.
[11] 2016 Va. Acts Ch. 758. The effective date was changed to July 1, 2018 pursuant to HB1774, 2017 Va. Acts Ch. 345.
[12] 9 VA. ADMIN CODE § 25-880 (2014).
[13] VA. CODE ANN. § 62.1-44.15:27.A (2014).
[14] VA. CODE ANN. § 62.1-44:15:51 (2013).
[15] 9 VA. ADMIN. CODE § 25-840-40(19) (2016). Minimum Standard 19 provides that "Properties and waterways downstream from development sites shall be protected from sediment deposition, erosion and damage due to increases in volume, velocity and peak flow rate of stormwater runoff for the stated frequency storm of 24-hour duration" in accordance with standards and criteria set forth in the regulation.
[16] Va. Code Ann. § 62.1-44.15:52.A (2015).

continue to administer the stormwater management water quantity requirements using the Energy Balance Method as part of its Erosion and Sediment Control Program.

In order to resolve rural Tidewater localities' concerns about the first "donut hole", Del. Hodges asked the Virginia Coastal Policy Center at William & Mary Law School to conduct an analysis of concerns about the 2016 legislation and potential solutions to the "donut hole" issue. The VCPC issued a report in November 2016,[17] after which Del. Hodges introduced HB1774 in the 2017 legislative session as an effort to address rural Tidewater localities' remaining concerns.

Organization of the Workgroup

Delegate Hodges selected the members of the Workgroup as follows:

Phil Abraham, Virginia Association for Commercial Real Estate
Russ Baxter, Virginia Deputy Secretary of Natural Resources
Doug Beisch, Stantec (Daniel Proctor, alternate)
Jeff Corbin, Restoration Systems LLC
Melanie Davenport, Virginia Department of Environmental Quality (Jaime Bauer Robb and Fred Cunningham, alternates)
Greg Evans, Virginia Department of Forestry
Jonathan Harding, Virginia Agribusiness Council
Eldon James, Rappahannock River Basin Commission
Ann Jennings, Chesapeake Bay Commission
Adrienne Kotula, James River Association
Lewis Lawrence, Middle Peninsula Planning District Commission
T.J. Mascia, Resource Environmental Solutions, LLC
Allyson Monsour, Clark Nexsen
David Nunnally, Caroline County
Marcie Parker, Virginia Department of Transportation (Scott Crafton and Chris Swanson, alternates)
Chris Pomeroy, AquaLaw PLC (Kate Creef, alternate)
Peggy Sanner, Chesapeake Bay Foundation (Joe Wood, alternate)
Curtis Smith, Accomack-Northampton Planning District Commission (Shannon Alexander, alternate)
Thomas Swartzwelder, King & Queen County
Michael Toalson, Home Builders Association of Virginia (upon retirement, replaced by Andrew Clark)
Shannon Varner, Troutman Sanders LLP (Patrick Fanning, alternate)
Sandra Williams, ATCS PLC

The CCRFR research team was composed of Dr. Carl Hershner, Virginia Institute of Marine Science (VIMS); Emily Steinhilber, Old Dominion University; Mujde Erten-Unal, Old Dominion University; and Xixi Wang, Old Dominion University. Special technical assistance was provided by Mike Rolband, Wetland Studies and Solutions, Inc. and Ryan Brown,

[17] Virginia Coastal Policy Center, *The 2016 Stormwater Bill: An Analysis of Perceived and Real Problems with Proposed Solutions* (2016).

KaneJeffries LLP. As per HB1774's requirements, the meetings were facilitated by Elizabeth Andrews, Virginia Coastal Policy Center. Representatives of the Virginia Association of Counties (VACo) and the Virginia Municipal League (VML) also attended and observed the meetings, and a representative of the Hampton Roads Planning District Commission was copied on all Workgroup communications.

The Workgroup split itself into two subcommittees to address different topic areas assigned to it by the legislation. Both Subcommittees 1 and 2 were comprised of members of the full Workgroup or their designated alternates. Subcommittee 1 researched the potential creation of a volume credit program, use of regional stormwater BMPs, and the treatment and use of stormwater in roadside ditches in rural Tidewater localities. Subcommittee 2 examined alternative methods of operating stormwater programs in rural Tidewater localities that were easier to administer but no less protective of water quality.

The Workgroup and both subcommittees met for a total of twelve times between July and November 2017. The dates of the meetings were as follows:

July 11th, 2017: Full Workgroup
August 1st, 2017: Subcommittee 2
August 3rd, 2017: Subcommittee 1
August 30th, 2017: Full Workgroup
September 6th, 2017: Subcommittee 2
September 13th, 2017: Subcommittee 1
September 27th, 2017: Subcommittee 2
September 29th, 2017: Full Workgroup
October 11th, 2017: Subcommittee 2
October 12th, 2017: Subcommittee 1
October 13th, 2017: Full Workgroup
November 29, 2017: Full Workgroup

Preliminary Matters

At its first meeting, the Workgroup discussed the fact that DEQ cannot take on administration of the Chesapeake Bay Preservation Act (CBPA) land disturbing activities without causing a fiscal impact. Therefore, the Workgroup decided to research other methods by which rural localities could administer a VSMP for the few development projects they may have that disturb less than an acre. The Workgroup agreed that its tasks were to:

1) Review and consider easier to administer alternative methods that could be used in rural Tidewater localities to meet or exceed the level of water quality protection and water quantity control provided by the Virginia Stormwater Management Program (VSMP) Regulation;

2) Consider the development of a volume credit program to fulfill water quantity requirements; and

3) Consider methods to create value for the stormwater in the networks of ditches that line the highways within such localities, including use of the water to generate volume credits.

As an initial matter, the Workgroup members decided that for all of their recommendations, there should not be any mandated, negative fiscal impact on the Commonwealth, localities, or the development community outside of non-Municipal Separate Storm Sewer System (MS4) CBPA localities. The Workgroup also took into consideration concerns voiced by rural Tidewater locality representatives with respect to existing stormwater management regulations. First, many rural Tidewater localities do not have adequate financial resources or personnel to implement and supervise stormwater management programs,[18] and they believe engineers are needed to implement the technical Energy Balance Method as set forth in the regulations for water quantity control.[19] Another concern of many rural Tidewater localities is that "donut hole" projects are few and far between, meaning that localities would not be able to justify hiring an engineer or otherwise increasing their staff as would be necessary to administer a stormwater management program for these few projects. Locality representatives on the Workgroup noted that, generally speaking, localities face recurring issues related to technological knowledge, as they often do not have the requisite financial and staffing resources to implement stormwater management regulations.

Additionally, rural Tidewater locality representatives expressed interest in streamlining the process for regulation of land disturbances in the "donut hole," in order to make it easier for locally owned small businesses to develop land. Often, the only businesses that have the requisite resources to comply with complex stormwater management requirements are larger chain stores, rather than locally owned small businesses. In Mathews County, some citizens had also expressed a desire for TMDLs to be developed for stormwater in ditches. Finally, rural localities expressed concern that they have abundant water resources and green infrastructure[20] and they are attempting to find new partnerships between urbanized areas and non-MS4 localities and with the private sector in order to make meaningful progress in restoring water quality in the Chesapeake Bay.

At the first full Workgroup meeting, a proposal was discussed to utilize tiered impervious cover thresholds to determine applicable water quantity requirements, with different stormwater regulations applying to watersheds with different levels of impervious cover. This was later subsumed into the work of Subcommittee 2. The initial presentation by Mike Rolband on this approach can be found in Appendix 2.

---

[18] The Virginia Erosion and Stormwater Management Act, *supra* note 11, will take effect on July 1, 2018 and will create an option whereby a non-MS4 locality may choose to administer a consolidated Virginia Erosion and Stormwater Management Program but DEQ will conduct stormwater management plan review on its behalf.
[19] 9 VA. ADMIN. CODE § 25-870-66 (2014).
[20] "Green infrastructure" generally refers to natural resources, such as forests and wetlands, that have the capacity to provide water quantity and quality benefits.

Development of Subcommittee 1 Recommendations Concerning the Stormwater in Ditches in Rural Tidewater Virginia Localities

The Subcommittee initially examined the possibility of creating a volume credit trading program for stormwater in ditches in rural Tidewater localities. Under this proposal, localities would capture and retain water from ditches as a means of generating credits for sale to permitted entities to assist them in meeting the stormwater water quantity requirements. Ryan Brown presented to the Subcommittee on a water quantity trading program in Washington, D.C. which allows for 50% of required retention to be met offsite through the purchase of Stormwater Retention Credits (SRCs). His report to the Subcommittee can be found in Appendix 3. It was noted in the presentation that Virginia, unlike Washington, D.C., has both water quality and water quantity technical criteria in order to meet stormwater regulations; therefore, even if the Commonwealth were to pursue a water quantity or volume trading approach, this would not meet any water quality obligations. Further, many of the trading programs that currently exist are located in more developed (or developing) areas, meaning that they have a greater number of potential buyers for their creditors than would most rural Tidewater localities. Any such program would also need to be constructed such that it would not run afoul of the existing nutrient and sediment credit trading programs in Virginia and would not degrade local water quality. Additionally, a program similar to that of Washington, D.C. would impose an increased administrative burden on rural localities that do not have the same resources as Washington, D.C. After hearing about the complexity of operating such a volume credit program, and about the lack of permitted entities in the area that would provide a market for these credits, the Subcommittee decided that a volume credit program would not be a viable alternative for rural Tidewater localities that have little permitted development and no permitted municipal separate storm sewer systems in the area.

The Subcommittee then considered the possibility of these localities capturing and treating unregulated, unpermitted stormwater from ditches and trading any nutrient or sediment credits generated. However, this approach would entail expanding the current credit trading area beyond a single river basin in order to find a market for the credits, which is not allowed under current law to protect local water quality. As such, the Subcommittee expressed concern that this proposal would be a significant divergence from the established trading program in the Commonwealth and the Chesapeake Bay Program. In particular, the established nutrient credit trading program has thus far been strictly restricted to trading within a particular river basin, with the ultimate goal of protecting *local* water quality. The Subcommittee also discussed the use of regional BMPS, but was unable to identify an entity that would be willing to fund such a program, given the fact that there is currently little market in rural Tidewater Virginia for nutrient or volume credits either from MS4s or from developers seeking offsite stormwater compliance options. The Subcommittee therefore decided not to pursue this proposal either.

The Subcommittee also discussed the possibility of utilizing Comprehensive Stormwater Management Plans as a means to address stormwater in ditches. However, upon further research, the requirements for these plans proved to be complex and beyond the scope of some rural Tidewater localities' administrative capacity. As the Workgroup was charged with analyzing different approaches to stormwater management that would be easier to administer for rural Tidewater localities, this approach was eschewed in lieu of a less complex option.

Instead, the group discussed the potential for a large-scale program to treat the water in ditches in rural Tidewater localities in order to create a significant enough reduction in pollutants that it would help the Commonwealth achieve its nonpoint source load allocation under the Chesapeake Bay Total Maximum Daily Load (TMDL).[21] The CCRFR research underlying these findings can be found in Appendix 5. The research team compiled and analyzed data to see if this approach would be practicable. As an initial matter, in order for such a proposal to be feasible, there must be a base level of nutrients within the ditches that could actually be captured and treated. Further, it must actually be cost-effective for localities to treat and capture them. The CCRFR researchers analyzed the ditch networks, looking first at the sub-watersheds, as these would be the location of any BMPs that would be established. Ultimately, the data indicated that this approach would not be realistic, as the amount of phosphorous that is actually in the ditches (and could be captured and treated) would be insufficient to make a significant difference; i.e., the amount of pollutant reduction achieved would not justify the cost of treating all ditches in the ditch network. The data also indicated that only some of the water in the ditches actually flows to a collection point at which it could potentially be treated for pollutant reduction. Additionally, within each county studied by the VIMS team, there were hundreds of collection points. Under this proposal, each of these collection points would have to be acquired, retrofitted with a BMP, and then maintained in the long term. Given the fact that many of these potential BMP sites are located on private property, maintenance of the BMPs under this approach would prove particularly difficult. For these reasons, the Subcommittee decided not to pursue this approach.

The data collected by VIMS, however, did indicate that much of the pollutant load that is in ditches in rural Tidewater Virginia is derived from agricultural uses. So the Subcommittee then turned to analyzing the development of targeted BMPs in order to reduce the agricultural pollutant load at a local scale rather than throughout the entire region. The Chesapeake Bay Program is currently in the process of reviewing ditch maintenance as an effective stormwater management practice, and is also considering the nutrient and sediment reduction efficiency to be assigned to it. The research team from ODU and VIMS therefore analyzed the possibility of targeted ditch management using King and Queen and Essex counties as examples for Tidewater Virginia. Their findings are summarized in Appendix 6. Following the presentation of this data, the Subcommittee recommended, and the Workgroup approved, the following list of seven recommendations as possible means by which the Commonwealth could fund such a program, pending completion of the Bay Program's review. Ultimately, the Subcommittee felt that this could provide an incentive to address flooding and water quality in unmaintained ditches in rural Tidewater localities, as defined above.

I. Option 1 - Stormwater Local Assistance Fund (SLAF)

The Subcommittee initially considered recommending creation of a subfund of SLAF as a funding source for nonpoint source pollutant load reduction in stormwater in ditches in rural Tidewater localities. As there is no legal mandate for localities to regulate this water, this proposal is an attempt to provide an incentive for them to do so.

[21] The Chesapeake Bay Program currently is considering agricultural ditch restoration practices as a possible means to achieve nutrient and/or sediment reduction credits. See background document in Appendix 4.

Under current regulations, only localities may apply for SLAF funding, and SLAF funds may only be used for capital projects. Further, any BMPs must be included on the Chesapeake Bay Program or Virginia Stormwater BMP clearinghouse, and only 50% of a given project's costs can be funded. SLAF funding also cannot be used to generate credits for sale through a nutrient trading program, and the law would not allow for credits to be given away to developers. Ultimately, the Subcommittee decided that the program as currently written would have to be changed considerably in order for it to be workable for the purposes of the Workgroup. This is in part because, in its current incarnation, SLAF funds cannot be used for operating costs, including administrative costs. Subcommittee 1 therefore agreed to recommend the creation of a separate SLAF subfund for use for roadside ditch management by localities that are members of the Rural Coastal Virginia Community Enhancement Authority (RCVCE).[22] The proposed subfund could provide up to 100% funding for these projects and could cover both capital and reasonable administrative costs. Under this recommendation, DEQ would be the agency responsible for deciding grant recipients and determining whether administrative costs are reasonable, given their current oversight of the existing SLAF program. The creation of such a subfund will require legislative amendments.

II. Option 2 - Water Quality Improvement Fund (WQIF)

The Subcommittee decided to recommend that the General Assembly allocate a portion of the WQIF funds for roadside ditch management proposals with the potential for nonpoint source nutrient reduction. Per statutory requirements, grant agreements for wastewater treatment projects are signed by the Director of the Department of Environmental Quality whether or not there is money in the fund for such projects. This could possibly be done for local government stormwater management proposals as well. Ultimately, the Subcommittee decided to include a statement of support for using WQIF funds for these projects without specific amendments to the Virginia Code.

III. Option 3 - Environmental Impact / Natural Resources Bonds

The Subcommittee recommended environmental impact/natural resources bonds as a potential source of funding in part due to the fact that federal funding in this area is likely to decrease in the future. The Subcommittee notes that one potential benefit of such a funding program is that it will ensure a financial interest in a given project's success. Three examples of existing projects that use natural resources bonds are the DC Water Environmental Investment Bonds, which share the risk of a BMP's failure, the Chesapeake Bay Foundation Environmental Impact Bond project, and the Forest Service Conservation Finance Program, which may now be expanded to address water quality. Reports on these bond programs can be found in Appendix 7.

The Subcommittee noted that in order for such a financing project to work, it is imperative that the projects are valuable enough that private investors would be willing to take a risk on them. This being the case, the applicability of natural resource bonds as a potential funding option is limited to those projects that could actually provide a revenue stream. The Subcommittee agreed that it does not intend that these projects would be exclusively funded by private sector actors; instead, private sector funds could be utilized under this approach as just

[22] 2017 Va. Acts Ch. 388.

one of several potential funding sources that may be used to assist localities. Additionally, these bonds can be structured so they do not utilize state debt capacity.

IV. Option 4 – Private Sector or State Agency Partnership with Rural Coastal Political Subdivisions, Including Potential Private Maintenance of VDOT Ditches

The Subcommittee discussed a number of possible options for private sector interests or a state agency to partner with a political subdivision to undertake ditch enhancement projects. First, localities could provide private sector actors with access to public lands in order for them to undertake water quality improvements that meet the requirements to generate DEQ-certified nutrient credits. Under this approach, the private sector actors would ultimately benefit from the generated credits.

Second, funds generated by the defined storm water service charge zones authorized by Chapter 586 of the 2016 Virginia Acts of Assembly[23] could be used by localities to contract with private entities to install water quality and quantity controls for a designated growth area in advance of expected development. The localities then could create a service charge for these designated areas in order to pay back the private investor. This approach could attract new development by ensuring that supporting infrastructure is already in place.

Third, pending the Chesapeake Bay Program's establishment of an assigned efficiency for roadside ditch management practices, such practices could be considered linear BMPs for development projects and third parties could negotiate maintenance agreements for them with the Virginia Department of Transportation (VDOT). The Subcommittee noted that localities would have to be involved in some way, as VDOT currently enters into maintenance agreements with localities (rather than, for example, homeowners associations). The Subcommittee concluded that existing VDOT guidance on this option could appropriately address the proper level of involvement on the part of the localities. Additionally, the Subcommittee agreed to use the broader term of "political subdivision" for the proposal with respect to access to public land, given the fact that entities such as public access and economic development authorities can own property.

The Subcommittee noted that there is currently no regulatory barrier to the implementation of such a program, but it wished to point out its support for such an initiative and highlight it for the General Assembly.

V. Option 5 – Inclusion of Roadside Ditch Management (RDM) in the Commonwealth's Phase III Watershed Implementation Plan

The Subcommittee also recommended including a statement of support for the inclusion of RDM practices in Phase III of the Commonwealth's Watershed Implementation Plan, pending approval by the Chesapeake Bay Program. One possible source of funding for this is Clean Water Act § 319 grants. As of yet, it is unclear how the Phase III WIP development will unfold in Virginia, but, during Phase II, DEQ worked with localities to derive lists of projects that could be completed in non-regulated areas. However, even if RDM is included in the Phase 3 WIP, it is

[23] 2016 Va. Acts Ch. 587 (*see* Appendix 8).

unclear if it would be eligible for § 319 funds. These funds are separated into two types: program funding and project funding. Project funds are restricted to implementing activities in EPA-approved implementation plans, but nine key elements must be met in order for a project to qualify for them. The activities in the Phase I and II WIPs do not meet those elements, and DEQ has not submitted them to the EPA for approval for funding under § 319.

Ultimately, the full Workgroup decided not to link this section of the proposal exclusively to § 319 funds, and, given the fact that there are a variety of federal funding opportunities beyond just § 319 grants, language was instead incorporated that delineated the "use of federal funds."

VI. Option 6 – Inclusion of Agricultural Ditch Practices in Virginia Agricultural Cost-Share BMP Manual

The Chesapeake Bay Program currently is researching and considering potential ditch management practices. An Agricultural Ditch BMP Expert Panel is analyzing management of agricultural ditches for possible establishment of nutrient and sediment reduction efficiencies that could be used to generate credits. Recommendations from this expert panel are not likely to be approved and efficiencies will not be established before July 1, 2018. Therefore, the earliest date by which such practices would be available as a cost-sharing practice would be fiscal year 2019. The Bay Program also is researching Roadside Ditch Management (RDM) practices, excluding drainage from agricultural lands. The Subcommittee proposed that the use of pollutant reduction practices for ditches should be included in the Virginia Agricultural Cost-Share BMP Manual once the Chesapeake Bay Program has established nutrient and sediment reduction efficiencies for these practices.

VII. Option 7 - Encourage Environmental Organizations or Localities to Undertake RDM Projects Like the Talbot County, Maryland Example

The Subcommittee also considered a report about a project based in Talbot County, Maryland and funded by the Chesapeake and Atlantic Coastal Bays Trust Fund, as a potential example of successful RDM projects.[24] The Talbot County project studied the implementation of various ditch restoration projects and developed a tool that identified roadside ditches with the greatest capacity for nutrient and sediment capture. The Subcommittee noted that the main goal of this project was to protect and restore local waters, not to create credits that could be sold. Essentially, for this project, the County used high-resolution topography data to target certain ditches, with over a thousand identified as possibilities for ditch treatment. The County ultimately pursued eight ditch projects over the course of three years, and the BMPs used were pocket wetlands, two-stage ditches, grass waterways, and bioswales.[25] Ultimately, the cost, per

---

[24] The Nature Conservancy, *Trust Fund Final Report* (2016) (*see* Appendix 9). *See also* Draft Technical Memo, *Draft Options for Crediting Pollutant Reduction from Roadside Ditch Management Practices (RDM) in the Chesapeake Bay Watershed* (2017) (Appendix 10).
[25] *Id*. at 5.

pound, of phosphorous removed was between $596 and $103,980.[26] The projects were located on private property and were completed in conjunction with the private landowners.

Ann Jennings reported to the Subcommittee several lessons that can be learned from this project. First, the report indicated that roadside ditches present a feasible opportunity for water quality improvements. Second, the report noted that the project achieved positive outcomes at a relatively low cost, as long as projects were kept simple and transparent. Third, according to the report, targeting practices were found to work best, and landowners were generally supportive of targeting the ditches with the greatest capacity for nutrient and sediment capture. And finally, community outreach and expedited project completion were key to the project's success. (Ann Jennings' report to the Subcommittee can be found in Appendix 9.)

The Subcommittee noted, however, that for implementation of this program elsewhere, it would be necessary to gather more information on different design efficiencies, especially for non-traditional practices. Further, the report does not indicate what parties are responsible for the permanent maintenance of any BMPs created under the program. Ultimately, the Workgroup decided to highlight this program for the General Assembly given the fact that localities or nonprofit organizations could pursue these types of projects using grant funding. However, the Subcommittee noted their concern that, for such a program, interests would probably have to be acquired in some private properties due to the fact that some BMPs may have to be located on private land. Relatedly, it would also be necessary to identify the parties responsible for permanent maintenance of the BMPs.

Development of Subcommittee 2 Recommendations Concerning Administration of Stormwater Management Requirements in Rural Tidewater Virginia Localities

Subcommittee 2 first considered a tiered approach to stormwater management water quantity requirements because locality representatives asserted that the Energy Balance Method is too complicated for localities to apply. This is particularly problematic given the fact that the Energy Balance Method is required by the Stormwater Management regulations' water quantity requirements. Locality representatives noted that, under prior regulations, local officials were used to implementing MS19 but the change to the Energy Balance Method in the stormwater management regulations complicated the process for them. However, the Subcommittee noted that MS19 has not been uniformly applied in the past, and the Erosion and Sediment Control Law and MS19 have different language, which has created some confusion. Due to the fact that MS19 is an appropriate regulatory option with respect to small sites in rural areas, the Subcommittee decided to consider whether the use of MS19 would be acceptable in limited circumstances.

As a preliminary matter, the Subcommittee agreed that the issue with respect to the uniformity of interpretation of MS19 needs to be resolved, however the Workgroup has too short of a timeframe to be able to address that issue. One possible solution to this issue would be to recommend that DEQ utilize a Regulatory Advisory Panel to clarify MS19. DEQ provided to the Workgroup its interpretation that the Erosion and Sediment Control Law dictates that the flow

[26] *Id*. at 9, 19.

capacity, volume, and velocity elements of MS19 are to be met by application of the Energy Balance Method. It is the position of DEQ that the Energy Balance Method is the only acceptable way to meet those criteria now, and that the elements of MS19 have been replaced. The Workgroup also discussed the fact that the Energy Balance Method was originally intended as a stopgap measure, and it was assumed that if a locality used it, then all of the MS19 criteria were met. However, other action is still required in situations where localities are granted an exception where use of the Energy Balance Method is not feasible.

Given the fact that the rural Tidewater localities that fall under the Workgroup's charge see only a few projects a year,[27] the Subcommittee first considered making its recommendations apply only to rural coastal localities with a certain rate of growth. Concern was expressed with respect to using population growth since these localities are already relatively unpopulated (and, thus, any population growth at all would appear significant). Percentage of impervious cover was then suggested as an alternative marker, but using this metric alone, localities in other parts of the state could possibly qualify under the proposal, which would be beyond the scope of the Workgroup's charge under HB1774. In order to address these concerns, the Subcommittee agreed to limit this particular proposal to localities that are eligible to be members of the RCVCE Authority,[28] and are also subject to the CBPA so that this proposal would only apply to the rural Tidewater localities under the Workgroup's charge.[29]

The Subcommittee also discussed the possibility of very small development projects being regulated under the common plan of development or sale concept set forth in the Virginia Stormwater Management Act, Va. Code § 62.1-44.15:24 *et seq.*, but ultimately decided not to pursue that because it was quite complicated. The Subcommittee agreed, however, that additional clarity and guidance are needed concerning common plans of development.

After reviewing alternatives, the Subcommittee ultimately decided upon a tiered approach to water quantity requirements for stormwater management only for these rural localities, based upon the percent of impervious cover in a watershed. The tiered approach aims to incorporate MS19 – which rural, coastal localities are comfortable with using – while still protecting water quality. The data provided by ODU and VIMS supporting this approach is explained in depth in Appendix 11. The Subcommittee research team analyzed stream quality versus impervious cover and found that there is first an impact on the receiving stream when there is between 5-10% impervious cover in the watershed. Therefore, the Subcommittee defined Tier A as to be used when there is 0-5% impervious cover in a watershed, and it is the tier for which localities may use MS19. This is because, realistically, at this impervious cover level the use of MS19 rather than the Energy Balance Method does not have a significant negative impact on receiving streams and associated water quality. For Tier B, which is to be used when there is 5-7.5% impervious cover in a watershed, localities would use MS19 enhanced with a 1 year, 24 hour release requirement. Some consider this to be protective of streams in low-density areas, but does not work as well in high-density areas. Therefore, Tier C, for watersheds with 7.5%

[27] See development data collected by Middle Peninsula and Accomack-Northampton Planning District Commissions, Appendix 11.
[28] 2017 Va. Acts Ch. 388.
[29] The Workgroup decided at its last meeting that this definition of rural Tidewater localities should apply to all of its recommendations.

impervious cover or more, requires the use of the stormwater management regulations' Energy Balance Method. Generally, the tiered approach incorporates calculations that are less complex on the low end of the development spectrum (*i.e.*, localities can use the MS19 standard), and incorporates more protective calculations as development increases.

One concern expressed by the Subcommittee was that within these localities there could be intensive pockets of development that may have more of an impact on water quality. The Subcommittee thus decided to allow localities to adopt more stringent regulations for such "areas of concern," where the locality is concerned about the impacts of development on the environment. Under the current law, localities already have the authority to impose more stringent requirements if certain procedures are followed.[30] However, the Subcommittee noted that under this approach, these procedures would not be triggered because a locality would only be applying the Energy Balance Method already required by state stormwater management regulations, rather than more stringent regulations.

The Subcommittee researched the use of the Virginia Geographic Information Network (VGIN) to establish the impervious cover percentages for use in the tiered approach. VGIN is a geographic information system (GIS) that provides geographic data for land throughout the Commonwealth. Under this approach, VGIN mapping information and data would be used by localities in order to establish the percentage of impervious cover for a watershed. The Subcommittee discussed the use of the program StreamStats, another GIS system, however it is only updated every 5 years, whereas VGIN is planned to be updated more frequently. Due to the fact that VGIN is thus more accurate, the Subcommittee chose to recommend that localities be required to use VGIN in order to generate maps and land cover data under this proposal. The Subcommittee decided not to recommend that ordinances must be updated with these maps, so localities would not have to go through ordinance review each time. The Workgroup ultimately decided to include language stating that maps and associated data sets must be updated "at least annually," as historical data indicates that there would not be full percentage point jumps in the percent of impervious cover in a watershed within the annual window.

The Workgroup noted that a definition of "impervious cover" may not be necessary, given the fact that VGIN has a set definition, and that VGIN data will form the baseline for the impervious cover percentage calculation. However, should a definition be found necessary, the Workgroup recommended amending the definition of "impervious cover" in the stormwater management regulations to echo the definition in the CBPA regulations.[31] This definition would apply only to the tiered approach for rural Tidewater localities. Further, the tiered approach is optional for rural Tidewater localities, however, if they choose to adopt the tiered approach, they must use the methodology set out in this proposal. Finally, the Workgroup also noted that a high level of scientific analysis was necessary in order to reach this recommendation, as can be seen in Appendix 11, and a similar level of analysis would be necessary if this proposal were to be considered for expansion beyond the rural Tidewater localities.

[30] VA. CODE ANN. § 62.1-44.15.33 (2014).
[31] 9 VAC § 25-830-40 (2015).

Additional Recommendations Discussed by the HB1774 Workgroup

I. Professional Engineer Stamp/Seal Recommendation

The Workgroup heard from locality representatives noting that rural localities in Tidewater Virginia often do not have the resources sufficient to retain experts on staff to review and approve stormwater management plans for the very few development projects that disturb less than an acre. Under this proposal, rural Tidewater localities may require that a licensed professional engineer retained by the applicant stamp/seal plans and supporting calculations in lieu of local plan review and the requirement for a local certified plan reviewer. As part of this proposal, the Workgroup agreed that stormwater management plans and supporting calculations must be stamped/sealed with a certification that states: "This plan is designed in accordance with applicable state law and regulations." This obviates the need for a locality official who has been certified by DEQ to stamp/seal the plans. The Workgroup discussed that there is precedent for this approach in other programs, such as inspections by third party soil scientists and building inspectors, and inspection of water treatment facilities. This proposal would only apply to the subset of rural Tidewater localities set out in the first section of this Report, given the very few development projects that disturb less than one acre in those localities.

II. Agreement in Lieu of a Plan Recommendation

Subcommittee 2 also conducted research into whether it would be possible to expand the use of an Agreement in Lieu of a stormwater Plan (ALP) for smaller, non-residential sites that disturb 2,500 square feet up to one acre. As the law currently stands, an ALP can be used only for a single family residence. Based on preliminary data compiled by members of Subcommittee 2, the Subcommittee concluded that the current ALP template may not be sufficient to meet water quality requirements for non-residential development. Therefore the Subcommittee chose not to expand this to other forms of development. The full Workgroup discussed the issue and considered whether localities should be authorized to decide the terms of the ALP themselves, similar to the process currently used for an ALP for erosion and sediment control, rather than using a DEQ template for the ALP. The Workgroup agreed to include a statement of support for further research into this option in the future, in light of the potentially low pollutant loads from these small development sites and the low number of such projects in rural Tidewater localities.

III. Budget Amendment or Appropriation Act Provision Proposal

The Workgroup also considered a proposal to request a budget amendment or Appropriation Act provision from the General Assembly to allocate funding for DEQ to administer the current stormwater management program for land disturbing activities within the "donut hole" in rural Tidewater localities. This was originally suggested as a less expensive alternative to having DEQ and localities implement changes to the current stormwater management program. Concern was expressed in the Workgroup that such a funding option was not feasible. Further, it was noted that even if funding were provided in one fiscal year, it could be revoked in another, in which case the Workgroup would not have achieved its goals. Additionally, the Workgroup noted that DEQ has insufficient resources for the program as it currently stands. Therefore, given the fact that the other proposals suggested by the Workgroup were deemed sufficient, the Workgroup agreed not to pursue this proposal.

IV. Increasing the Regulatory Threshold Statewide to 1 Acre

Finally, the Workgroup discussed a proposal to raise the regulatory threshold for stormwater management to one acre statewide for consistency and to get rid of the CBPA "donut hole." Ultimately, this approach was abandoned by the Workgroup in light of the other, more tenable solutions that were proposed, as well as due to concerns about potential water quality impacts.

Final HB1774 Workgroup Recommendations

The Workgroup came to consensus on this report and its recommendations. The representatives associated with Virginia state government (the Department of Forestry, Department of Transportation, Department of Environmental Quality, the Secretary of Natural Resources' Office, and the Chesapeake Bay Commission) noted that they participated in the work of the group and identified no technical concerns, but recused themselves from voting on the recommendations since the report involves potential legislation. Additionally, DEQ noted that the stormwater management program, in general, needs sustainable funding.

The Workgroup agreed that all of its recommendations apply to rural Tidewater localities, which the Workgroup defined as localities within the Northern Neck, Middle Peninsula, and Accomack-Northampton Planning Districts that are eligible to join the Rural Coastal Virginia Community Enhancement Authority established by § 15.2-7600 and are subject to the provisions of the Chesapeake Bay Preservation Act, § 62.1-44.15:67. The Workgroup also noted that, throughout their discussions, they thought of Caroline County as one of the localities that should be covered by these recommendations, and data from Caroline County was used as part of the Workgroup's decision-making process.

I. Subcommittee 1 Recommendations Concerning the Stormwater in Ditches in Rural Tidewater Virginia Localities

Proposed Funding Mechanisms for Ditch Management Practices

Roadside Ditch Management (RDM) practices are currently under review by the Chesapeake Bay Program. Based on recent Chesapeake Bay Program Urban Stormwater Workgroup discussion and the work of the Bay Program's Agricultural Ditch BMP Expert Panel, the earliest estimated date by which nutrient and sediment reduction efficiencies for such practices could likely be approved is the 2nd or 3rd quarter of 2018. The HB1774 Workgroup recommends the following seven funding proposals to the General Assembly and Governor for consideration once the Bay Program has established efficiencies for RDM practices. A consideration to keep in mind for all RDM practices is that they may require the acquisition of interests in private land, due to encroachment on adjacent properties when constructing BMPs for linear ditches. The potential funding options recommended by the Workgroup to address stormwater in ditches in rural Tidewater localities are:

1. The Workgroup is aware of draft legislation initiated by the Rappahannock River Basin Commission concerning amendments to the Stormwater Local Assistance Fund (SLAF) (currently authorized by Item 370(C) in Chapter 836 of the 2017 Acts of Assembly (2017 Budget Bill)); to be found in § 62.1-44.15:29.1 upon the effective date of the 2016 consolidation bill, 2016 Va. Acts Ch. 758). This Workgroup is not opposed to such legislation, but was charged by HB1774 (2017) with studying the administration of stormwater management programs only in rural localities in Tidewater Virginia. With that focus in mind, and with the goal of establishing a state level funding source for reducing the unregulated nonpoint source pollutant load, **the Workgroup recommends that the General Assembly create a subfund of the SLAF to make funding available to localities that are members of the Rural Coastal Virginia Community**

Enhancement Authority established by § 15.2-7600, for use in funding RDM practices. The Workgroup recommends that such subfund be administered by the Department of Environmental Quality (DEQ). The Workgroup recommends that a locality should be able to apply for up to 100% funding for such practices, including capital and reasonable costs for administering grant-funded projects, as determined by DEQ. These practices represent an opportunity for cost effective pollutant removal.

2. **The Workgroup recommends that the Governor and General Assembly support the use of the Water Quality Improvement Fund (WQIF) for RDM practices following the Bay Program's approval of nutrient and sediment reduction efficiencies for them.**

3. **The Workgroup recommends that the Governor and General Assembly support the concept of Environmental Impact/Natural Resources Bonds to help fund RDM projects** (or other projects/practices) (see, *e.g.*, the D.C. Water Environmental Impact Bond and Chesapeake Bay Foundation Environmental Impact Bond, Appendix 7). Since these would be private sector funds to assist localities, these bonds could be structured to have no impact on the Commonwealth's debt capacity.

4. **The Workgroup recommends that the Governor and General Assembly support the concept of the private sector or a state agency partnering with rural political subdivisions in Tidewater Virginia to address water quality and quantity issues**. A non-MS4 rural locality is unlikely to address local water quality or quantity issues without some driver or incentive (primarily in the form of compensation). The private sector already provides a cost effective option to effectively address the phosphorous load from new development. Nutrient banks, representing private investment in permanent nutrient reduction projects, exist that can serve all rural areas in Tidewater Virginia (except the Eastern Shore where a bank application is currently pending DEQ's approval). It will be important for any initiative to not disrupt that carefully crafted market. Possible options include:

   a) A political subdivision partnering with a private sector entity to undertake water quality projects on public lands (which may provide water quantity benefits as well). The political subdivision may be able to provide access to public lands for the private sector to undertake water quality improvements that meet the requirements to generate DEQ-certified credits. Ideally these improvements would be implemented in the near term rather than as each new development project occurs. A portion of the resulting credits could be provided on negotiated terms to the political subdivision for its own needs and to attract new development to the area. Potential issues with private sector approaches include i) the question of whether the area's potential water quality projects are of the type that could generate certifiable credits, and ii) whether there is a sufficient market for the resulting credits to justify the private sector investment. No change in statute or regulation is necessary to implement this recommendation.

b) A locality establishing a stormwater service charge pursuant to § 15.2-2114 to partner with third parties to pay for stormwater improvements, as authorized by Chapter 587 of the 2016 Acts of Assembly. The Workgroup recommends that § 15.2-2114.J.3 be amended to clarify that any locality may accept the participation of property owners *directly or through a third party* in a stormwater management private property program.

c) A locality establishing a service district or districts under existing or new legislative authority for specific geographic areas where the locality, with the assistance of private investment, would like to concentrate and promote growth while protecting water quality. Water quantity and/or quality control improvements could be located in appropriate locations within the service district/growth area in advance of the hoped-for development as a means to promote rural development growth areas as contemplated by HB1774.

d) Using RDM practices as linear BMPs for development projects once the Chesapeake Bay Program has established nutrient and sediment reduction efficiencies for RDM practices. A third party could negotiate with VDOT to take on responsibility for restoring and maintaining the requisite number of feet of VDOT ditches to generate sufficient water quality credits to comply with water quality requirements. This would require a permanent maintenance agreement and easement, locality involvement when necessary, and the approval of ditch maintenance standards that would generate credits. The result would be less maintenance expense for VDOT and more flexible options for third parties.

5. **The Workgroup recommends that the Governor and General Assembly support inclusion of RDM practices in the Commonwealth's Phase III Watershed Implementation Plan following approval of assigned efficiencies for these practices by the Bay Program, which may facilitate use of federal grant funds for these practices.**

6. **The Workgroup recommends that the Governor and General Assembly support the approval of agricultural ditches with pollutant reduction practices for inclusion in the Virginia Agricultural Cost-Share BMP Manual following approval of assigned efficiencies for such practices by the Chesapeake Bay Program, in order that they can be included in the Virginia Agricultural Cost-Share Program administered by the Department of Conservation and Recreation and become eligible for cost-share funding**.

7. **The Workgroup recommends that environmental organizations or localities should be encouraged to undertake RDM projects such as the Talbot County, Maryland example**, where ditches are cleaned out and widened, or converted to wetlands with an easement to ensure perpetuity, driven by a desire for better water quality. A consideration for this approach is that it will require grant funding or some other source of revenue.

II. Subcommittee 2 Recommendations Concerning Administration of Stormwater Water Quantity Requirements in Rural Tidewater Virginia Localities

The Workgroup recommends a Tiered Approach to water quantity requirements for stormwater management for rural localities in Tidewater, Virginia that elect to use it, as follows:

The Workgroup recommends that the Commonwealth adopt Impervious Cover percentage (IC%)-based water quantity control requirements for rural Tidewater localities as defined by the Workgroup. Such approach would require these localities to:

1. Establish Tiered Level for Water Quantity Control Requirements, for Land Disturbing Activities of 2,500 sq. ft. up to one acre.

Tier	I.C. %	SWM Requirement
A	0 to < 5.0%	Current MS-19
B	5.0 to < 7.5%	1yr – 24hr Release
C	≥ 7.5%	Current Standards – Energy Balance

2. Establish Maps for Application of Stormwater Management Requirements.

A. If a locality chooses to adopt this approach, it shall adopt a map (a projected IC% map), reflected in its ordinances, that combines existing IC% with local knowledge of their desired projected buildout IC%. In adopting its map, the locality may designate certain areas of denser development or environmentally sensitive areas within the watershed where the Energy Balance Method applies instead of this tiered approach. These areas shall be shown on the IC% map and in the locality's ordinance. The map shall depict the geographic boundaries of the locality's watershed using the most recent version of Virginia's 6th order National Watershed Boundary Dataset, depicting which IC% tier applies to each watershed, or, alternatively, identifying IC% for portions of these watersheds based on expected development patterns in the locality. The locality initially shall use the most recent version of the Virginia Geographic Information Network (VGIN) data to establish its IC% map, augmented by local knowledge of existing development. Use of the VGIN data shall be deemed an acceptable starting point for determination of IC%. After that, localities shall update their maps and supporting datasets with actual development project information at least annually, including single family home projects and projects covered by the General VPDES Permit for Discharges of Stormwater from Construction Activities and administered by the Department of Environmental Quality for opt-out localities. Localities may choose to incorporate into their maps the most recent VGIN data as it is updated, which would include state and federal projects that are not reviewed or approved by local governments. The locality shall track and make available to the public its IC% as reflected in its annually updated map. If a locality opts to use this tiered approach, it shall be subject to DEQ review.

B. If a project is approved for construction and will result in an exceedance of the watershed IC% threshold defined in the locality's map, then it must meet the current standards using the Energy Balance Method (or a more stringent alternative).

3. Update IC% Mapping.

If a project development plan is approved that exceeds the IC% of a locality's map, and it changes the IC% tier of a watershed, the locality must update the IC% map within 12 months of approval of the project and notify DEQ.

Additionally, the Workgroup recommends that DEQ utilize a Regulatory Advisory Panel to clarify MS19.

Background: The Workgroup agreed to limit this particular proposal to localities that are members of the RCVCE Authority,[32] and are also subject to the CBPA so that this proposal would only apply to the rural Tidewater localities under the Workgroup's charge. The Workgroup also noted that a high level of scientific analysis was necessary in order to reach this recommendation, as can be seen in Appendix 11, and a similar level of analysis would be necessary if this proposal were considered for expansion beyond the rural Tidewater localities.

III. Additional HB1774 Workgroup Recommendations

1) Authorization for Rural Tidewater Localities (as defined by the Workgroup) to Accept Stamped/Sealed Plans From a Licensed Professional in Lieu of Local Plan Review for Rural Localities in Tidewater Virginia. **The Workgroup recommends that both a VSMP/VESCP authority and a Tidewater Virginia locality that has opted out of administering a VSMP program be authorized to require and accept stamped/sealed plans and supporting calculations from a licensed professional retained by the applicant in lieu of local plan review and the requirement for a local certified plan reviewer.** The Workgroup recommends that plans and supporting calculations must be stamped/sealed with a certification that states: "This plan is designed in accordance with applicable state law and regulations." A performance bond will still be required per § 62.1-44.15:34 of the Stormwater Management Act and § 62.1-44.15:57 of the Erosion & Sediment Control Law.

Background: Section 62.1-44.15:27.H of the Stormwater Management Act already allows a VSMP authority to contract directly with "third-party professionals who hold certificates of competence in the appropriate subject areas, as provided in subsection A of § 62.1-44.15:30, to carry out any or all of the responsibilities that this article requires of a VSMP authority, including plan review and inspection but not including enforcement." This section also allows a VSMP authority to require monitoring reports from "the person responsible for meeting the permit conditions to ensure compliance" and efficacy, while § 62.1-44.15:58 allows a VESCP authority to do the same. In addition, § 62.1-44.15:28 states that the regulations must

[32] 2017 Va. Acts Ch. 388.

require that “all final plan elements, specifications, or calculations whose preparation requires a license under Chapter 4 (§ 54.1-400 *et seq*.) or 22 (§ 54.1-2200 *et seq*.) of Title 54.1 be appropriately signed and sealed by a professional who is licensed to engage in practice in the Commonwealth.”

2) Agreement in Lieu of a Plan Recommendation

The Workgroup recommends that there be further research on the concept of expanding the Agreement in Lieu of a Plan (ALP) to nonresidential development sites of less than one acre in rural Tidewater localities (as defined by the Workgroup), using a different ALP template than is currently used by DEQ for single family homes.

APPENDICES

Appendix 1. Enabling Legislation

VIRGINIA ACTS OF ASSEMBLY -- 2017 SESSION

CHAPTER 345

An Act to amend and reenact the tenth enactments of Chapters 68 and 758 of the Acts of Assembly of 2016 and to direct the Commonwealth Center for Recurrent Flooding Resiliency to convene a work group relating to stormwater and erosion control; local rural development growth areas; volume credit program; regional stormwater best management practices banks.

[H 1774]

Approved March 13, 2017

Be it enacted by the General Assembly of Virginia:

1. *§ 1. That the Commonwealth Center for Recurrent Flooding Resiliency shall convene a work group to examine opportunities to improve stormwater management in rural localities that are located in Tidewater Virginia, as defined in § 62.1-44.15:68 of the Code of Virginia. The work group shall review and consider alternative methods that could be used in such localities to meet or exceed the level of water quality protection and water quantity control provided by the Virginia Stormwater Management Program (VSMP) Regulation, 9VAC25-870, including (i) the creation of rural development growth areas within such localities, in which stormwater management could be administered by the localities using different approaches than those set forth in the VSMP Regulation; (ii) the development of a volume credit program to fulfill water quantity requirements; (iii) the payment of fees to support regional stormwater best management practices; and (iv) the allowance of the use of the stormwater in the networks of ditches that line the highways within such localities to generate volume credits.*

§ 2. That the work group created by this act shall be facilitated by the Virginia Coastal Policy Center at William and Mary Law School and shall include representatives of the Virginia Institute of Marine Science, Old Dominion University, the Virginia Department of Transportation, the Virginia Department of Environmental Quality, the Chesapeake Bay Commission, local governments, environmental interests, private mitigation providers, the agriculture industry, the engineering and development communities, and other stakeholders as determined necessary.

§ 3. That in order to support the efforts of the work group created by this act, the Commonwealth Center for Recurrent Flooding Resiliency shall provide comprehensive analysis of the appropriate regulatory sections, and alternatives developed by the work group, with the goal of determining the difference in water quality benefits provided.

§ 4. That the Commonwealth Center for Recurrent Flooding Resiliency shall report the results of the examination conducted by the work group created by this act, including recommendations for any legislative or regulatory measures needed to improve the administration of stormwater management by rural localities, to the Governor, the Chairman of the House Committee on Agriculture, Chesapeake and Natural Resources, and the Chairman of the Senate Committee on Agriculture, Conservation and Natural Resources no later than January 1, 2018.

2. That the tenth enactments of Chapters 68 and 758 of the Acts of Assembly of 2016 are amended and reenacted as follows:

10. That the provisions of this act shall become effective July 1, ~~2017~~ *2018*, or 30 days after the adoption by the State Water Control Board of the regulations required by the ninth enactment of this act, whichever occurs later.

3. That the provisions of the first enactment of this act shall expire on January 1, 2018.

Appendix 2. Mike Rolband's presentation on the Tiered Approach (7/11/17)

HB1774 Stormwater Work Group

July 11, 2017

Michael S. Rolband
P.E., P.W.S., P.W.D., LEED® AP

Wetland Studies and Solutions, Inc.
5300 Wellington Branch Drive · Suite 100
Gainesville · Virginia 20155
www.wetlandstudies.com

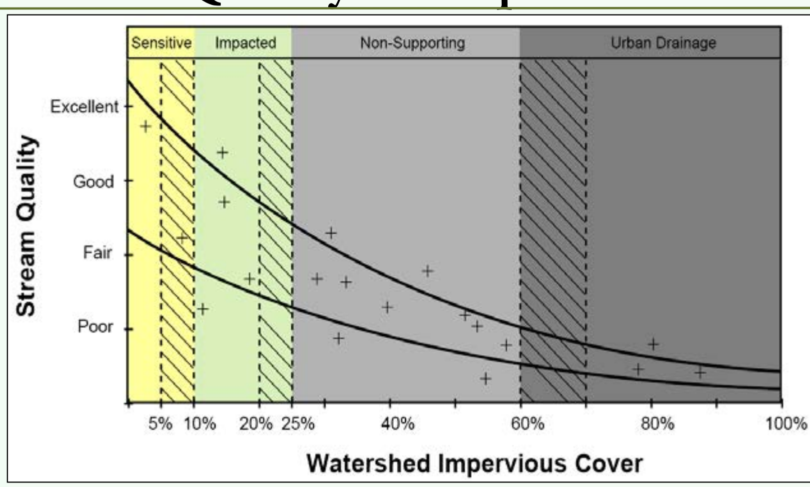
Agenda

1. The Problem
2. Stream Quality vs Impervious Cover
3. Chesapeake Bay Executive Order 13508
4. Energy Balance Theory
5. What does Energy Balance Mean for the Private Sector?
6. MS-19 Enhancement (1-Yr Detention)
7. Proposal: Tiered Impervious Cover Thresholds to Determine Water Quantity Requirements
8. Reference Material (MS-19)

Wetland Studies and Solutions, Inc.

2

Stream Quality vs Impervious Cover



Schueler, T., Fraley-McNeal, L., and Cappiella, K. "Is Impervious Cover Still Important? Review of Recent Research." Journal of Hydrologic Engineering, April, 2009.

Note:
Current Water Quality of 0.41 lbs/ac/yr TP derived from 10% impervious cover, 30% turf, 60% forest

4

Chesapeake Bay Executive Order 13508

- "**Stormwater runoff requirements for federal development projects.** The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with **regard to the temperature, rate, volume, and duration of flow**." (EISA, Section 438)

- Section 502 Chapter 3 provides two options for "Implementation Policies to Preserve and Restore Predevelopment Hydrology:"
  - Option 1: "Retain the 95th Percentile Rainfall Event" – Volume Control
  - Option 2: "Site-Specific Hydrologic Analysis" – Mimic Pre-Settlement Conditions

- Retention is defined as "water will be evapotranspired, infiltrated or used onsite and not temporarily detained and discharged slowly over some predetermined period" (email correspondence with Robert Goo on April 6, 2010)

- In the Washington D.C. area, this means storms less than or equal to **1.7"** must be retained onsite

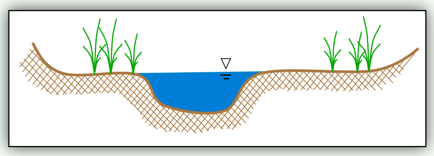
Wetland Studies and Solutions, Inc.

Energy Balance

The theory:

- Stable streams in this region and climatic epoch formed in forested watersheds and achieve stability by overbank flooding in the 1-1.5 year event.

- To prevent degradation, need to match peak flow, volume, and timing of such conditions.



Stream cross section at bankfull stage

- Traditional SW management controls peak flow, but increases volume, which increases stream power (and power degrades streams).

- Goal of the energy balance method:
  - Keeps pre-development power same by reducing peak flow rate if volume increases;
  - Provides a quantifiable incentive to match pre-development volume to the MEP; and
  - Mass Balance Equation: $Q*Rv_{post} = Q*RV_{forest}$

- Economic considerations of proposed version use pre-development conditions instead of forest (unlike state law and Fairfax County PFM), coupled with improvement factor, I.F. (The I.F. is required because state law requires an improvement on existing conditions.)

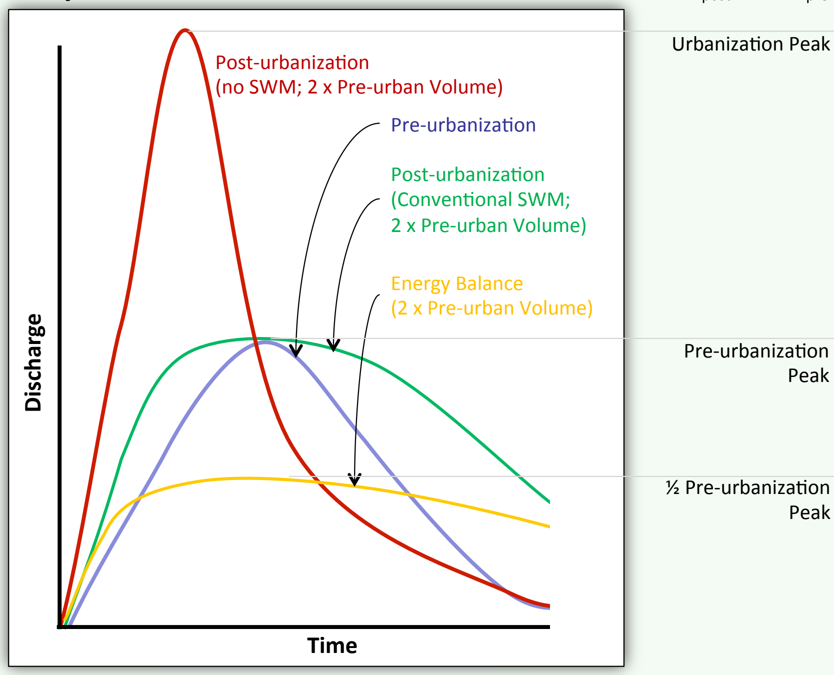
  - I.F. of 0.8 yields same ballpark SW sizing as forest conditions

Wetland Studies and Solutions, Inc.

Energy Balance

The theory:

Assume: $RV_{post} = 2*RV_{pre}$



What Does Energy Balance Mean for the Private Sector?

- Requires the Energy Balance of the 1-year, 24-hour storm with an improvement factor and no increase in 10-year peak flows, rather than conventional 2- and 10-year peak flow analysis;
- **No longer requires Adequate Outfall (MS-19) – Unless locality says otherwise**
  4VAC50-60-66.A: *"Compliance with the minimum standards set out in this section shall be deemed to satisfy the requirements of 4VAC50-30-40.19"*
- Pond footprints will typically be similar (±15%) because the 10-year Flood Protection governs the overall size (which matches most current requirements);
- The size of the 2-year orifice will be reduced to meet 1-year Energy Balance requirement; and
- The 1-year detention volume will usually be greater than the current 2-year volume requirement.

The regulations will result in the more effective use of SWM facilities to protect streams and reduce erosion/sediment at minimal cost.

Wetland Studies and Solutions, Inc.

MS-19 Enhancement (1-Yr Detention)

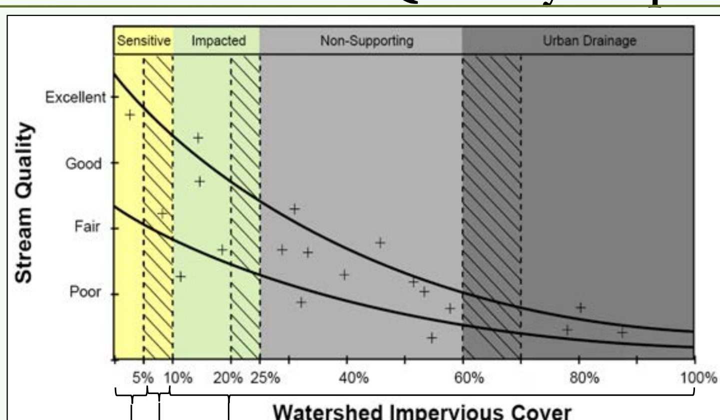
- 24 hour Release of Runoff from a 1-Yr, 24 hour storm
  - Anecdotal Guidance of good channel protection in low impervious cover sites
- The problem: the release rate is proportional to impervious cover.

Therefore, the more intensely developed the site – the higher the allowable release rate – opposite of the science

Wetland Studies and Solutions, Inc.

9

Proposal: Tiered Impervious Cover Thresholds to Determine Water Quantity Requirements



Tiered Protection Level

Option A		Option B
> 10%	Energy Balance	> 20%
5% - 10%	1-Yr, 24-Hr Release	10% - 20%
0% - 5%	Current MS-19	0% - 10%

Wetland Studies and Solutions, Inc.

10

Reference Material (MS-19)

Properties and waterways downstream from development sites shall be protected from sediment deposition, erosion and damage due to increases in volume, velocity and peak flow rate of stormwater runoff for the stated frequency storm of 24-hour duration in accordance with the following standards and criteria. Stream restoration and relocation projects that incorporate natural channel design concepts are not man-made channels and shall be exempt from any flow rate capacity and velocity requirements for natural or man-made channels:

a. Concentrated stormwater runoff leaving a development site shall be discharged directly into an adequate natural or man-made receiving channel, pipe or storm sewer system. For those sites where runoff is discharged into a pipe or pipe system, downstream stability analyses at the outfall of the pipe or pipe system shall be performed.

Wetland Studies and Solutions, Inc.

MS-19 (Continued)

b. Adequacy of all channels and pipes shall be verified in the following manner:

1) The applicant shall demonstrate that the total drainage area to the point of analysis within the channel is one hundred times greater than the contributing drainage area of the project in question; or

2) (a) Natural channels shall be analyzed by the use of a two-year storm to verify that stormwater will not overtop channel banks nor cause erosion of channel bed or banks.

(b) All previously constructed man-made channels shall be analyzed by the use of a ten-year storm to verify that stormwater will not overtop its banks and by the use of a two-year storm to demonstrate that stormwater will not cause erosion of channel bed or banks; and

(c) Pipes and storm sewer systems shall be analyzed by the use of a ten-year storm to verify that stormwater will be contained within the pipe or system.

Wetland Studies and Solutions, Inc.

MS-19 (Continued)

c. If existing natural receiving channels or previously constructed man-made channels or pipes are not adequate, the applicant shall:

1) Improve the channels to a condition where a ten-year storm will not overtop the banks and a two-year storm will not cause erosion to channel the bed or banks; or
2) Improve the pipe or pipe system to a condition where the ten-year storm is contained within the appurtenances;
3) Develop a site design that will not cause the pre-development peak runoff rate from a two year storm to increase when runoff outfalls into a natural channel or will not cause the predevelopment peak runoff rate from a ten-year storm to increase when runoff outfalls into a manmade channel; or
4) Provide a combination of channel improvement, stormwater detention or other measures which is satisfactory to the VESCP authority to prevent downstream erosion.

d. The applicant shall provide evidence of permission to make the improvements.

e. All hydrologic analyses shall be based on the existing watershed characteristics and the ultimate development condition of the subject project.

Wetland Studies and Solutions, Inc.®

MS-19 (Continued)

f. If the applicant chooses an option that includes stormwater detention, he shall obtain approval from the VESCP of a plan for maintenance of the detention facilities. The plan shall set forth the maintenance requirements of the facility and the person responsible for performing the maintenance.

g. Outfall from a detention facility shall be discharged to a receiving channel, and energy dissipators shall be placed at the outfall of all detention facilities as necessary to provide a stabilized transition from the facility to the receiving channel.

h. All on-site channels must be verified to be adequate.

i. Increased volumes of sheet flows that may cause erosion or sedimentation on adjacent property shall be diverted to a stable outlet, adequate channel, pipe or pipe system, or to a detention facility.

j. In applying these stormwater management criteria, individual lots or parcels in a residential, commercial or industrial development shall not be considered to be separate development projects. Instead, the development, as a whole, shall be considered to be a single development project. Hydrologic parameters that reflect the ultimate development condition shall be used in all engineering calculations.

Wetland Studies and Solutions, Inc.®

MS-19 (Continued)

k. All measures used to protect properties and waterways shall be employed in a manner which minimizes impacts on the physical, chemical and biological integrity of rivers, streams and other waters of the state.

l. Any plan approved prior to July 1, 2014, that provides for stormwater management that addresses any flow rate capacity and velocity requirements for natural or man-made channels shall satisfy the flow rate capacity and velocity requirements for natural or man-made channels if the practices are designed to

i. detain the water quality volume and to release it over 48 hours;
ii. detain and release over a 24-hour period the expected rainfall resulting from the one year, 24- hour storm; and
iii. reduce the allowable peak flow rate resulting from the 1.5, 2, and 10-year, 24-hour storms to a level that is less than or equal to the peak flow rate from the site assuming it was in a good forested condition, achieved through multiplication of the forested peak flow rate by a reduction factor that is equal to the runoff volume from the site when it was in a good forested condition divided by the runoff volume from the site in its proposed condition, and shall be exempt from any flow rate capacity and velocity requirements for natural or man-made channels as defined in any regulations promulgated pursuant to § 10.1-562 or 10.1-570 of the Act.

Wetland Studies and Solutions, Inc.

MS-19 (Continued)

m. For plans approved on and after July 1, 2014, the flow rate capacity and velocity requirements of § 10.1-561 A of the Act and this subsection shall be satisfied by compliance with water quantity requirements in the Stormwater Management Act (§ 10.1-603.2 et seq. of the Code of Virginia) and attendant regulations, unless such landdisturbing activities are in accordance with 4VAC50-60- 48 of the Virginia Stormwater Management Program (VSMP) Permit Regulations.

n. Compliance with the water quantity minimum standards set out in 4VAC50-60-66 of the Virginia Stormwater Management Program (VSMP) Permit Regulations shall be deemed to satisfy the requirements of Minimum Standard 19.

Wetland Studies and Solutions, Inc.

Appendix 3. Stormwater Quantity/Volume Trading: Summary of Programs in Other Jurisdictions and Existing Regional Offsite Quantity Options in Virginia

STORMWATER QUANTITY/VOLUME TRADING: SUMMARY OF PROGRAMS IN OTHER JURISDICTIONS AND EXISTING REGIONAL OFFSITE QUANTITY OPTIONS IN VIRGINIA

House Bill 1774 (2017) (http://lis.virginia.gov/cgi-bin/legp604.exe?171+ful+CHAP0345) created a work group to review and consider, among other things, the development of a volume credit program to fulfill required stormwater management water quantity requirements. This report is a brief overview of information pertaining to existing programs that may be useful to the group in considering this topic. Much of the focus and reference materials relate to the primary volume credit trading program in existence, found in Washington, D.C. Other models are mentioned, however, as well as Virginia's current allowance for comprehensive/regional stormwater management planning and a list of specific considerations/questions that may need to be considered as a part of the work group's evaluation.

WASHINGTON, D.C. STORMWATER RETENTION CREDITS

WHAT IS THE D.C. RETENTION STANDARD?

- D.C.'s stormwater program contains retention-based technical criteria. In brief, regulated activities are required to retain the 1.2 inch storm, or the 0.8 inch storm for substantial improvement (i.e., redevelopment) projects. Fifty percent of the required retention must be met through onsite practices. The remaining fifty percent can either be met onsite, or as described below, offsite through the purchase of Stormwater Retention Credits or the payment of an in lieu fee.

WHAT ARE STORMWATER RETENTION CREDITS?

- Stormwater Retention Credits (SRCs) equate to one gallon of retained stormwater for one year. They can be generated by both regulated projects and unregulated sites, and sold to other regulated projects needing credits to meet compliance standards.

GENERATION/CERTIFICATION OF STORMWATER RETENTION CREDITS

- The D.C. Department of Energy & Environment (DDOE) certifies SRCs for stormwater best management practices (BMPs) and land cover in D.C. To be eligible, the BMP or land cover must:
  1. For regulated projects, achieve retention volume in excess of regulatory requirements (either retention of the 1.2 inch storm, or of the 0.8 inch storm for substantial improvement projects); or
  2. For voluntary stormwater retrofits or projects, achieve retention volume in excess of preproject retention.

- In both cases, there is an "SRC ceiling", or cap, on credits beyond the 1.7 inch storm. In total, then, SRCs may be generated by retention achieved above the baseline for the project (whether the 0.8 inch storm, 1.2 inch storm, or preproject retention as applicable), up to the 1.7 inch storm ceiling.

- Applications for SRCs include completed SRC calculation spreadsheets, as-built plans, and a signed maintenance agreement or contract. DDOE both initially certifies SRCs from retention BMPs, inspects them on an ongoing basis, and tracks. DDOE will certify up to 3 years' worth of SRCs; at the end of the 3-year period, the BMP owner may apply for another 3 years' worth of SRCs (the 3 years is based upon DDOE's inspection frequency).

- SRCs have a one year lifespan that commences as of the date that they are used in meeting offsite retention volume requirements.

USE OF STORMWATER RETENTION CREDITS

- A regulated site must achieve 50% of its required volume retention on site (except in demonstrated hardship cases). It can then purchase the remaining 50% through SRC purchases, or by paying an in lieu fee to DDOE (in the current setting, the in lieu fee is notably higher on a per gallon basis than SRCs are trading for; current/past trade values can be found at: https://octo.quickbase.com/up/bjkxxcfcp/g/rb7/eg/va/levels.html?sitelevel=1&pagerecord=167&userrole=Everyone%20on%20the%20Internet).

- SRCs can be purchased from any SRC-generating project in D.C.

- Projects using SRCs for compliance purposes are required to maintain the retention achieved off site for the life of their project—so they must continue to buy SRCs, which are sold on a one-year basis, for each year, or pay DDOE's in-lieu fee. Credits can be "banked" by purchasers for future years (any length of time), so the SRC purchase does not have to occur annually, so long as each year's required offsite retention is accounted for.

VOLUME TRADING IN OTHER JURISDICTIONS

- The Comfort Lake-Forest Lake Watershed District (a 47-square mile District in Minnesota) allows stormwater volume banking in a program structured very similarly to that in D.C. See Section 2.5, beginning on page 13 at: http://www.clflwd.org/documents/CLFLWD_Rules.pdf. An application form can be found at: http://www.clflwd.org/documents/CLFLWDSWVolumeReductionCreditBankingApplicationForm.pdf. An explanation of how regulated sites comply with the District's water volume reduction criteria is found at: http://www.clflwd.org/documents/CLFLWDStormwaterVolumeManagementStandardChecklist.pdf.

- Other jurisdictions have adopted programs allowing or requiring fees to be paid to the locality (e.g., pro rata payments or utility fees) based on the estimated volume of stormwater coming from a property. These fees are then used to fund projects elsewhere in the jurisdiction directed at volume reduction. In some cases, credits against the fee are given for practices installed on site. While this does not involve trading between properties in the same sense as in the D.C. and Minnesota program, these programs are mentioned here to illustrate that there are multiple ways an offsite volume reduction program can be structured, with various levels of locality responsibilities. A singular, but prominent example can be found in the City of Philadelphia's program, the details of which can be found at: http://www.phila.gov/water/wu/stormwater/Pages/default.aspx. A 2013 study by Natlab (a collaborative effort amongst The Nature Conservancy, EKO Asset Management Partners, and the Natural Resources Defense Council) both explains the Philadelphia program and analyzes alternatives for program/policy enhancements and may be found at: https://www.nrdc.org/sites/default/files/green-infrastructure-pa-report.pdf (see especially Chapter 4: Off Site Mitigation).

EXISTING OFFSITE WATER QUANTITY OPTIONS IN VIRGINIA

- In addition to options for water quality, localities currently have the ability to offer offsite water quantity compliance options for regulated projects. 9VAC25-870-69 (http://law.lis.virginia.gov/admincode/title9/agency25/chapter870/section69/), 9VAC25-870-92 (http://law.lis.virginia.gov/admincode/title9/agency25/chapter870/section92/), and 9VAC25-870-99 (http://law.lis.virginia.gov/admincode/title9/agency25/chapter870/section99/), in combination, allow for regional approaches through comprehensive stormwater management plans, and funding through pro rata fees.

- Comprehensive/regional approaches are in use in Virginia currently (for example, Fairfax and Henrico), and can be used for both water quantity and water quality compliance. This does create economy and efficiency for the regulated community, but also permanent maintenance responsibilities for the localities in most cases.

- In the ideal case, regional stormwater plans identify environmental features of a watershed that should be protected, and measures are strategically located. When constructed, stormwater management facilities can be built to accommodate not only existing development but projected future development. Maintenance is centralized with the locality.

- Regional facilities do require management by the locality. The comprehensive stormwater management planning process likewise requires funding and administration by the locality, as does property acquisition for sites where facilities can be located. Funding mechanisms do need to be developed for planning, facility construction, and long-term maintenance.

CONSIDERATIONS

- D.C. utilizes a retention requirement for compliance, whereas Virginia has both Water Quality and Water Quantity technical criteria. Should Virginia develop a standalone quantity/volume trading approach, water quality requirements would still need to be accounted for.

- Were any volume "trading" program set up, it would need to be determined on what scale such a program would operate (locally, regionally, statewide), who the program authority would be (again, a locality, a regional entity, or a state agency), and the location (distance, watershed, locality/region, etc.) where any credits that are generated could be used.

- Current comprehensive stormwater management plans/regional BMPs/stormwater utilities in Virginia are typically locality-based. The possibility of allowing these to be developed/administered by a regional entity for more rural localities could be discussed.

- Credits (SRCs) in the D.C. program have a lifespan of one year, with the project being responsible for continuing to maintain compliance through its lifespan (i.e., post-construction) either through additional SRC purchases or the installation of onsite practices. The lifespan/long term compliance method (as well as associated administrative responsibilities and costs) would need to be decided for any volume trading program in the Commonwealth.

- Whatever framework is selected (e.g., private trading, utilities, etc.), the necessary funding and the means of obtaining that funding would need to be determined. Note that most of the significant trading programs, as well as programs where the locality provides its own offsite options, exist in more developed/developing areas where there may be more potential credit purchasers and thus greater opportunities to generate revenue to support the program.

- Virginia currently has the Nonpoint Nutrient Offsets program, by which sites can meet a portion of their water quality requirements by purchase of offset credits. Any development of a quantity trading program would need to avoid negative impacts to that existing program.

    - As a related consideration, while trading programs typically deal in individual units (e.g.., a gallon of infiltrated stormwater, a pound of phosphorus, etc.), the practices that achieve these measured reductions also have other accompanying water quality and quantity (and other) benefits separate from the unit purchased. These accompanying benefits are typically deemed to be part of the overall benefit to water quality/quantity that backs up the trading programs and are not intended to be double counted (and in many cases, including in the Nonpoint Nutrient Offsets program, are specifically prohibited from being double counted).

- Where trading is authorized, there is still typically a minimum threshold of onsite treatment (in this case, retention) that is required in order to avoid unacceptable impacts to local water quality or quantity. This means that stormwater plans are still developed, and practices are still installed onsite (meaning administrative burdens are still borne by the program authority).

Appendix 4. Agricultural Ditch BMP Panel Update Report

Agricultural Ditch BMP Panel: Update/Review

Prepared for the Agriculture Workgroup
6/27/2017

Nutrient Management Section
DELAWARE DEPARTMENT OF AGRICULTURE

Delaware DEPARTMENT of AGRICULTURE
Serving Agriculture and Protecting Consumers

Panel Background

- Existing and soon to be approved NRCS BMPs related to ditches are not currently credited in Chesapeake Bay Model
- BMPs installed in ditch systems represent a potentially significant source of nutrient/sediment reductions
- 70% of Delaware's tax ditches and most of Maryland's 821 miles of ditches are in the Chesapeake Bay watershed

Panel Charge

- Define which specific BMPs have sufficient research to warrant inclusion in the CBWM.
- Define the conditions in which a reporting agency can receive a nutrient and/or sediment reduction credit for a BMP.
- Define the units to report practices to the CBWM.
- Recommend procedures for reporting, tracking and verification of the BMPs.
- Analyze any potential unintended consequences associated with the BMPs.

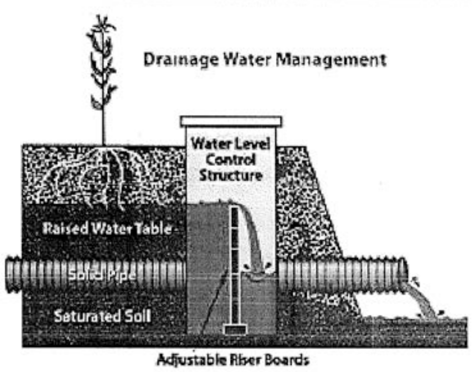
Panel Membership

Panelist	Affiliation
Ann Baldwin	National Resource Conservation Service
Ray Bryant	USDA Agricultural Research Service
Brooks Cahall	DNREC Drainage Program
Laura Christianson	University of Illinois
Dan Jaynes	USDA Agricultural Research Service
Chad Penn	USDA Agricultural Research Service
Stuart Schwartz	University of Maryland, Baltimore County
Andy Ward	Ohio State University

BMPs

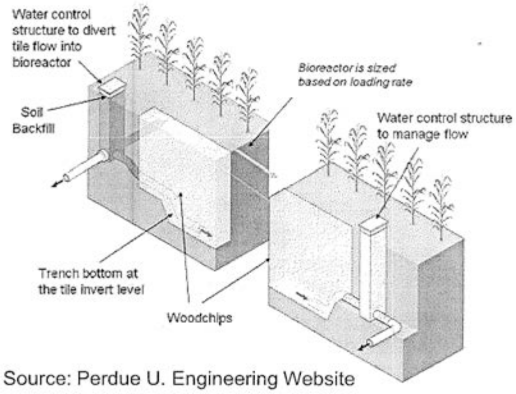
- Drainage Water Management/Structure for Water Control
- Channel Bed Stabilization
- Subsurface Drain
- Denitrifying Bioreactors
- Vegetated Subsurface Outlet/Saturated Buffer
- Open Channel/Two-Stage Ditch
- Phosphorus Removal System
- Gypsum Curtain
- Blind Inlet
- Ditch Dipouts

Drainage Water Management/ Structure for Water Control

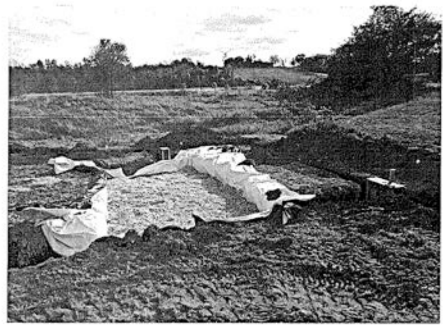


Source: USDA-NRCS Website

Denitrifying Bioreactor

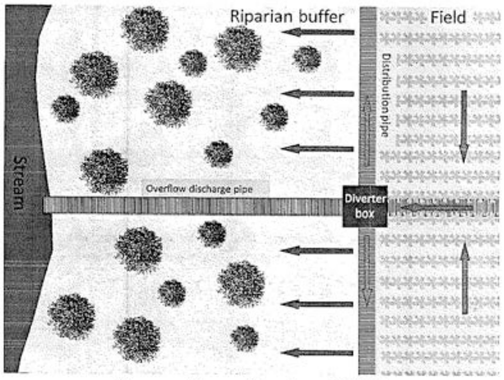


Source: Perdue U. Engineering Website

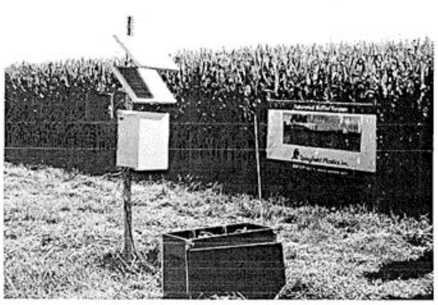


Source: Upper Susquehanna Coailition Website

Vegetated Subsurface Outlet/ Saturated Buffer

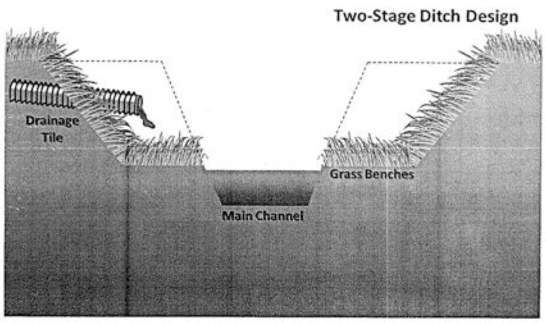


Source: Bruce Atherton, NRCS



Source: FarmWeekNow.com

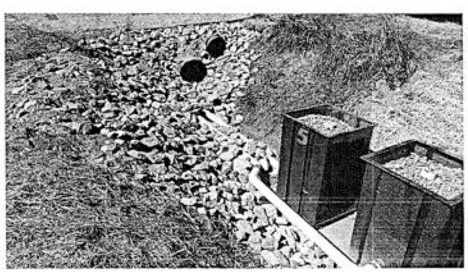
Open Channel/Two Stage Ditch



Source: Livable Future Blog


Source: Perdue U. Engineering Website

Phosphorus Removal System



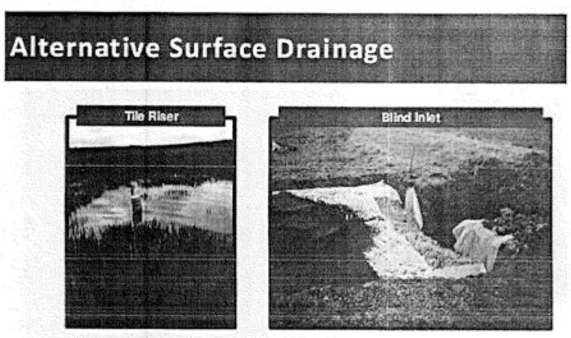

Source: C. Penn USDA-ARS

Gypsum Curtain

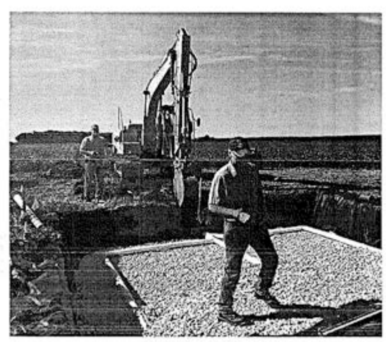
Source: CSA News Magazine

Source: Bay Journal

Blind Inlet

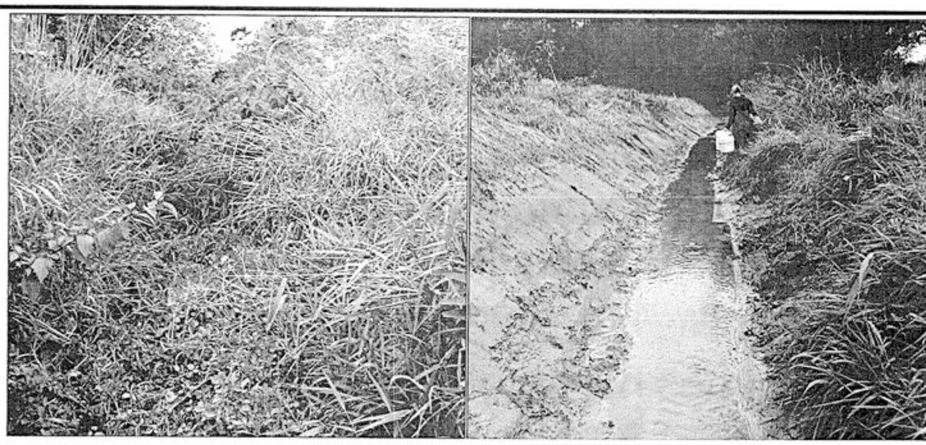


Source: Douglas Smith, USDA-ARS



Source: Times Bulletin

Ditch Dipouts



Source: American Fisheries Society

Current/Future Steps

- Public stakeholders meeting complete
- As sections are finished, they will be released to the panel membership for review, Denitrifying Bioreactor, Two-Stage Ditch, Blind Inlet out for panel review
- Panel will review sections, Bay Program staff will help with shaping the review and logistics

Appendix 5. Background Research for Subcommittee 1: Comprehensive Ditch Management

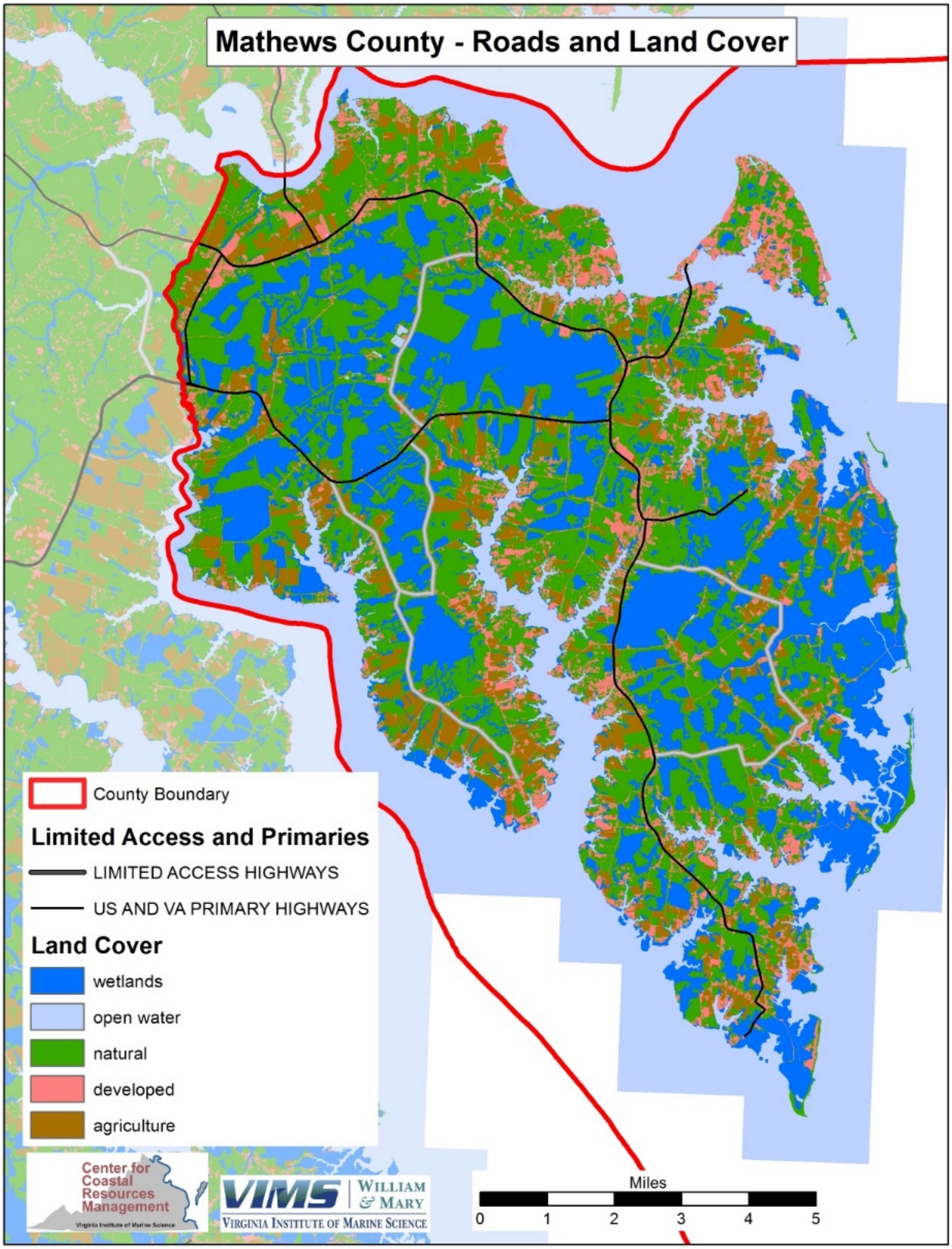
Roadside ditch detection and estimating potential for BMP installation to treat ditch water

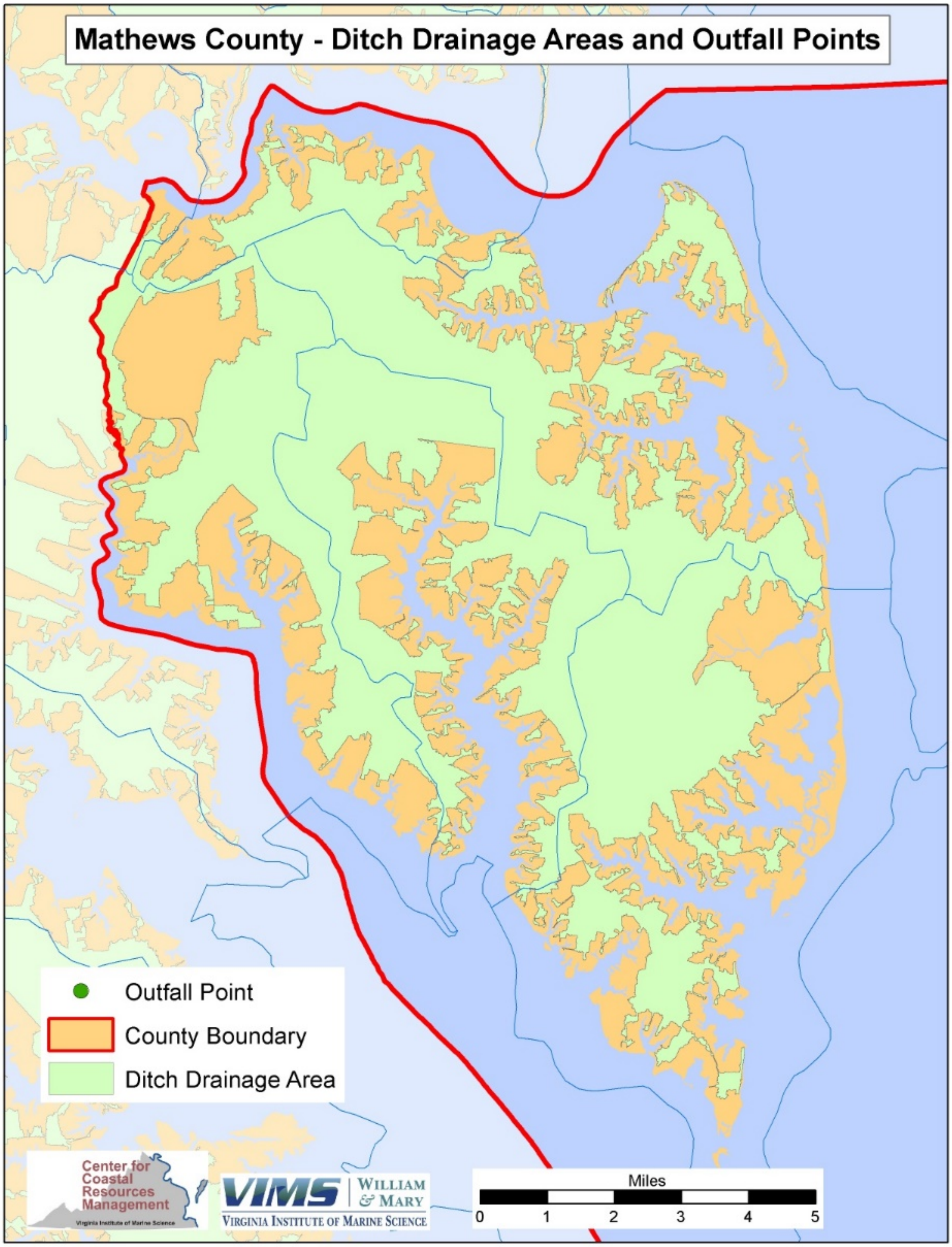
Roadside ditches were located using high resolution lidar elevation models. This allowed estimation of locations and volumes. Drainage patterns determined from the lidar information allowed analysis of probable flow paths in ditches and potential points for collection and treatment of ditch water. Using road locations, landcover, and elevations the efficacy of using BMP installations to treat ditch water could be assessed.

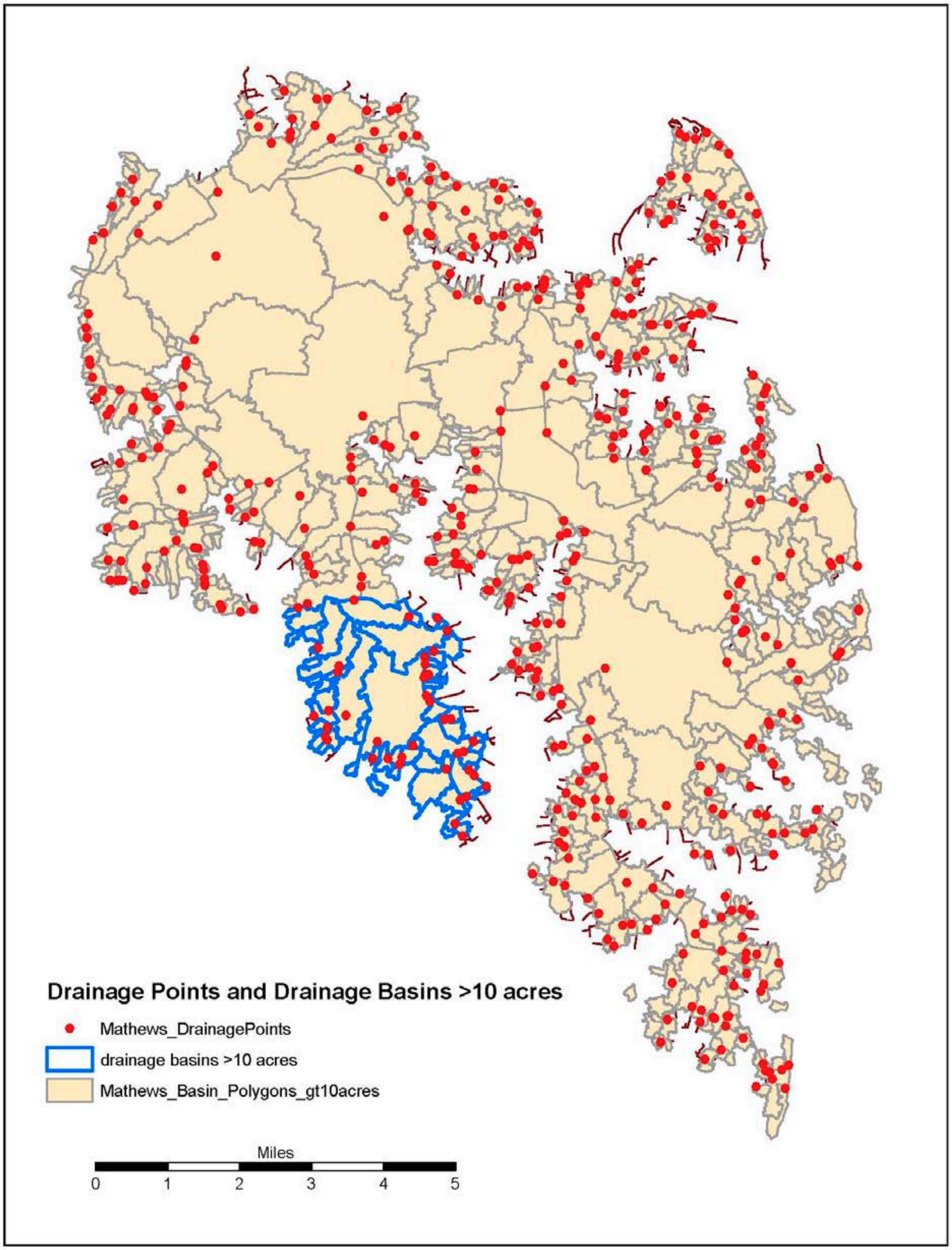
The test area for these analyses was Mathews County.

i. FINDINGS

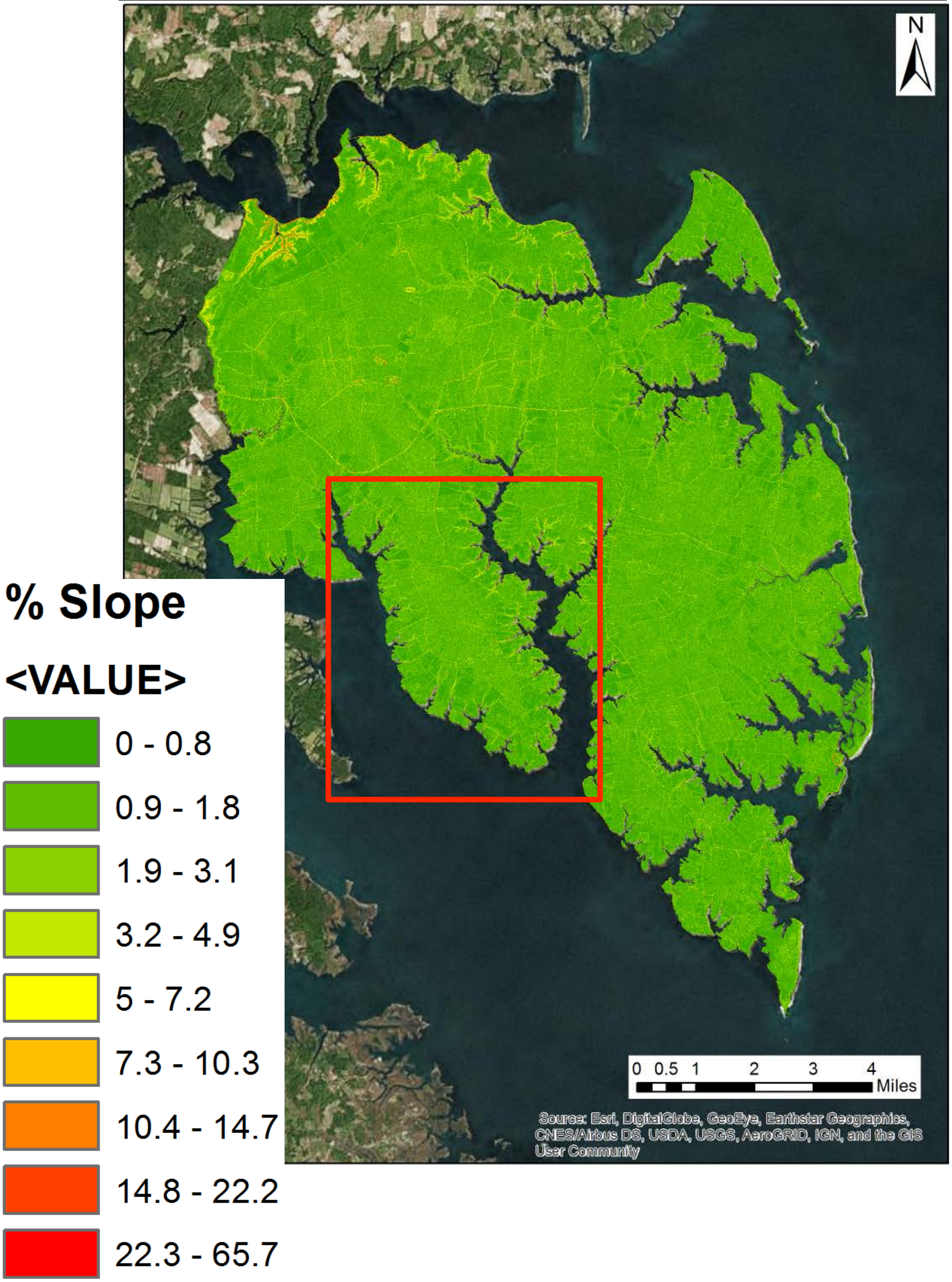
- lots of ditches, volume, and potential pollutant loads
- capturing and treating is not easy
  - low relief = lots of collection points
  - BMP site are generally not on public lands
  - ditches that would be effective collection channels are also not typically on public land
- trading market issues
  - ditch water volume only has “value” on-site
  - reduction in ditch water pollutant loads has “value” but the logical trading markets (MS4 localities) are generally outside currently allowable trade zones


Mathews County - Roads and Land Cover
County Boundary
Limited Access and Primaries
LIMITED ACCESS HIGHWAYS
US AND VA PRIMARY HIGHWAYS
Land Cover
wetlands
open water
natural
developed
agriculture
Center for Coastal Resources Management
VIMS
WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE
Miles
0
1
2
3
4
5

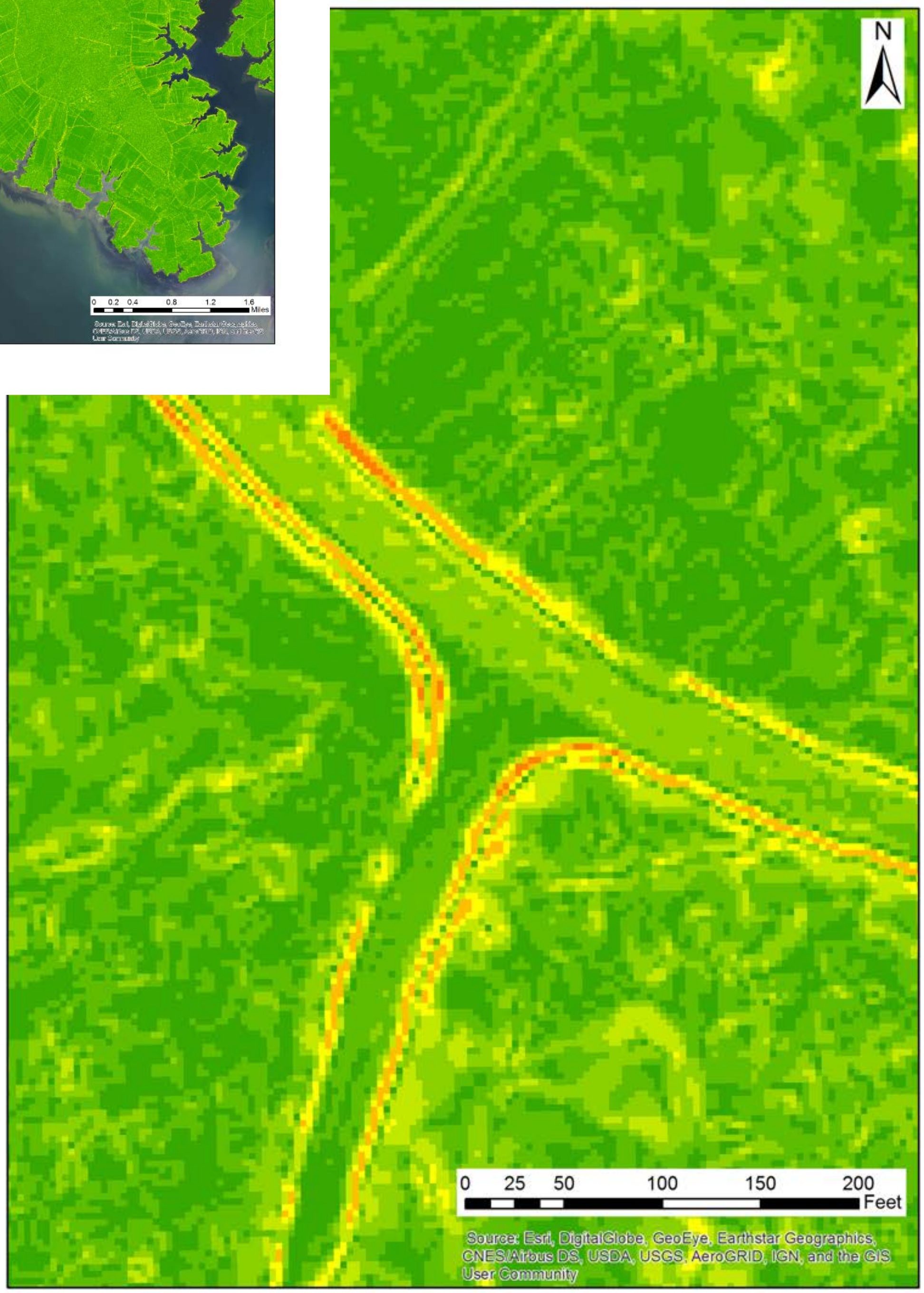

Mathews County - Ditch Drainage Areas and Outfall Points
Outfall Point
County Boundary
Ditch Drainage Area
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science
Miles
0
1
2
3
4
5

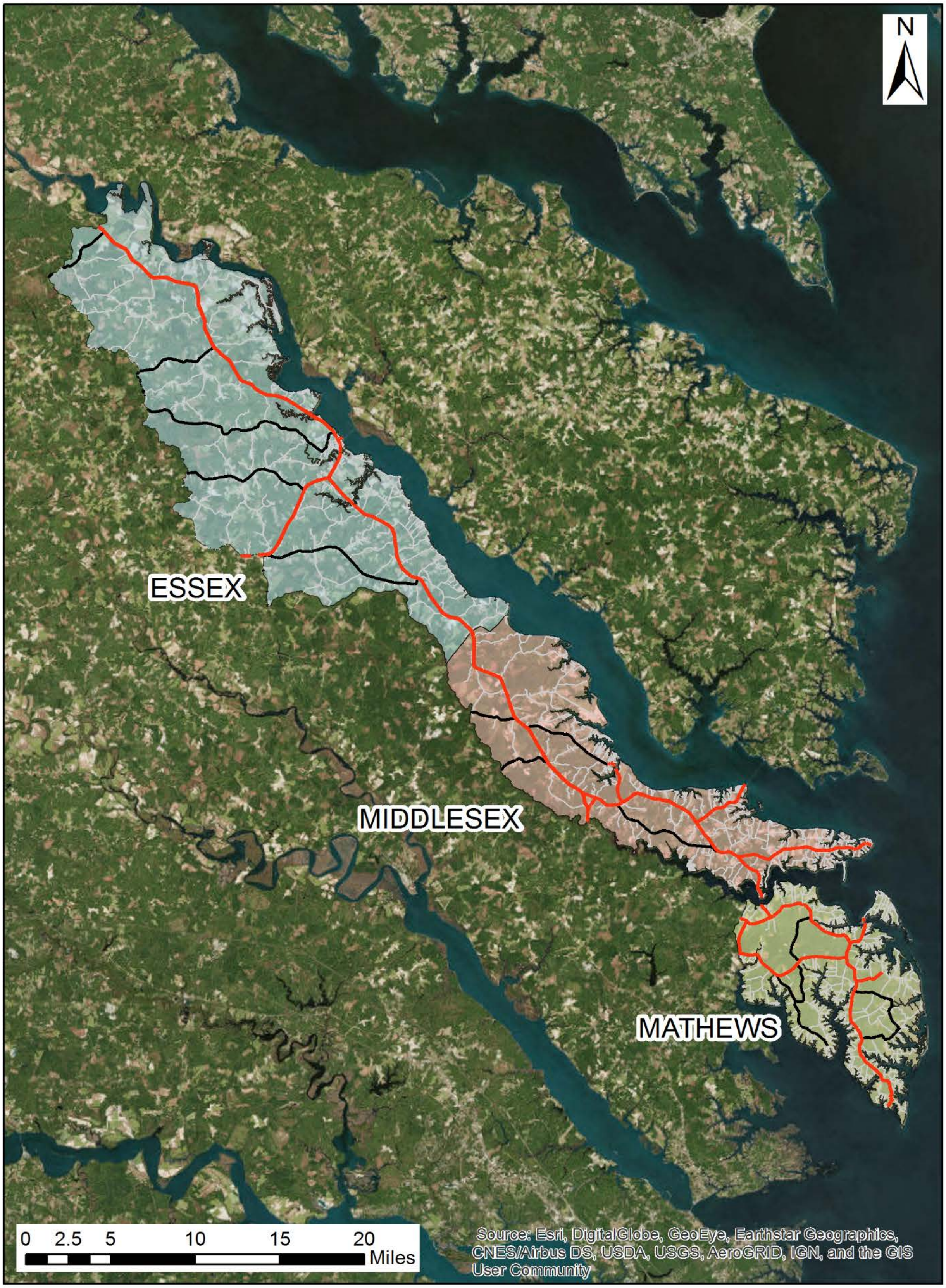

Drainage Points and Drainage Basins >10 acres
Mathews_DrainagePoints
drainage basins >10 acres
Mathews_Basin_Polygons_gt10acres
Miles
0
1
2
3
4
5

Lidar ditch detection in Mathews County



Lidar road and lane ditch detection in Mathews County




N
ESSEX
MIDDLESEX
MATHEWS
0 2.5 5 10 15 20
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Roadside ditches in Mathews, Middlesex, and Essex counties

Mathews County	Segments	Ditch length (feet)
state roads	145	364,208
local roads	58	202,516
private roads	1,031	2,322,726
Middlesex County		
state roads	315	720,182
local roads	80	201,106
private roads	1,863	2,952,161
Essex County		
state roads	344	921,764
local roads	101	502,951
private roads	1,096	3,282,776

Comprehensive Ditch Management

This work arose from the idea that aggressive efforts to capture and treat most of the roadside ditch water in the rural localities in the Northern Neck, Middle Peninsula, and Eastern Shore might generate enough load reduction to significantly affect water quality in the main stem of the Chesapeake Bay. Under the TMDL, this might represent a significant enough reduction to allow expansion of the nutrient trading zones so that MS4 communities outside the region might be permitted to trade, creating a market for rural community BMP applications.

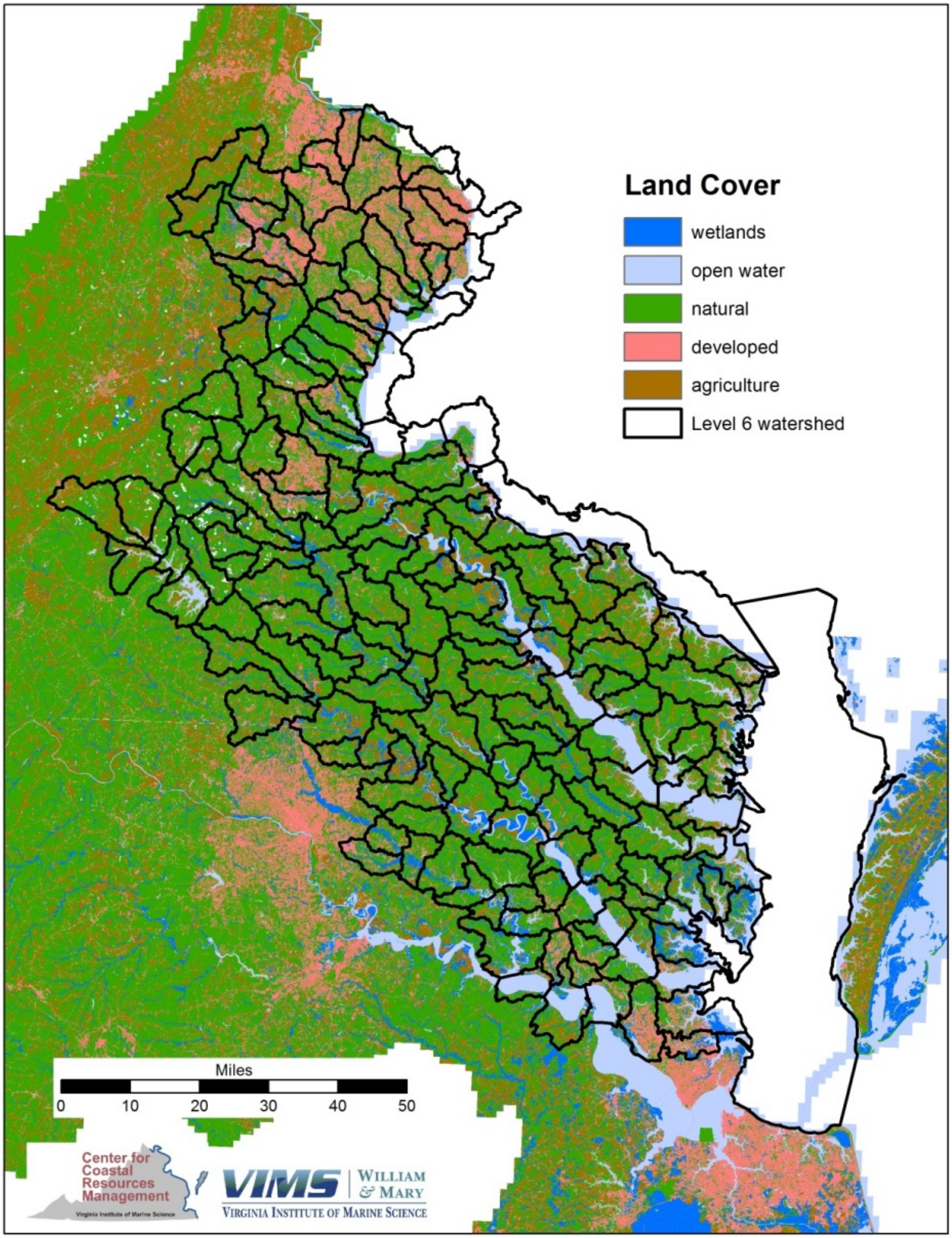
To generate a first order assessment, we looked at potential loads available for reduction in rural localities by examining landcover within roadside ditch drainage areas. Using Chesapeake Bay Program estimates for loads derived from general landcover types, estimates of loads were generated. Using methods from Appendix 1, numbers of BMP installations and locations were evaluated for Middlesex and Essex and counties.

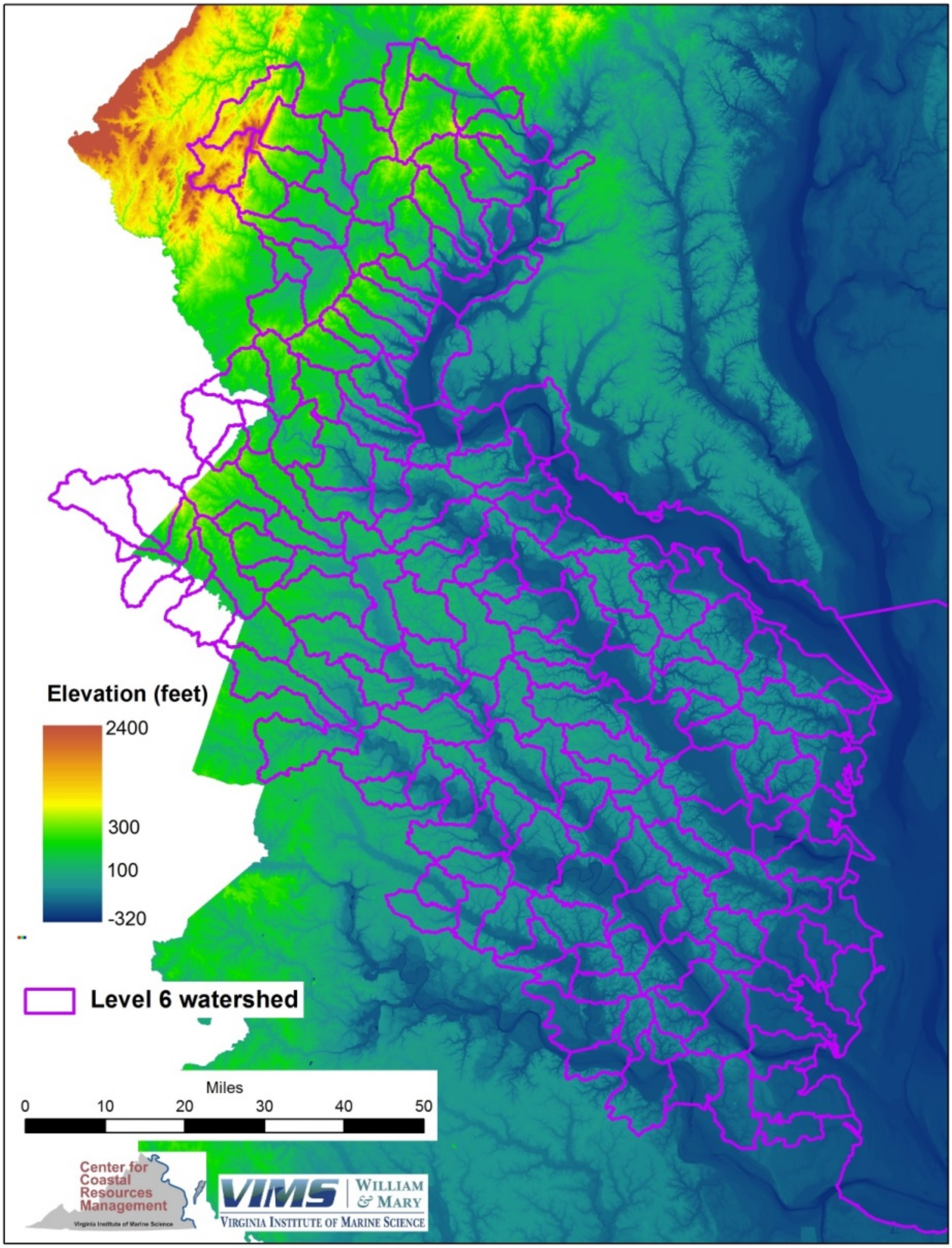
i. FINDINGS

- requires large scale implementation
- cumulative loads could be significant, but:
- capture and treatment not practical
    - too many “pour points” for ditch network
    - bmp site ownership issues
    - long term maintenance could be an issue
- requires reconsideration of allowable trade zones

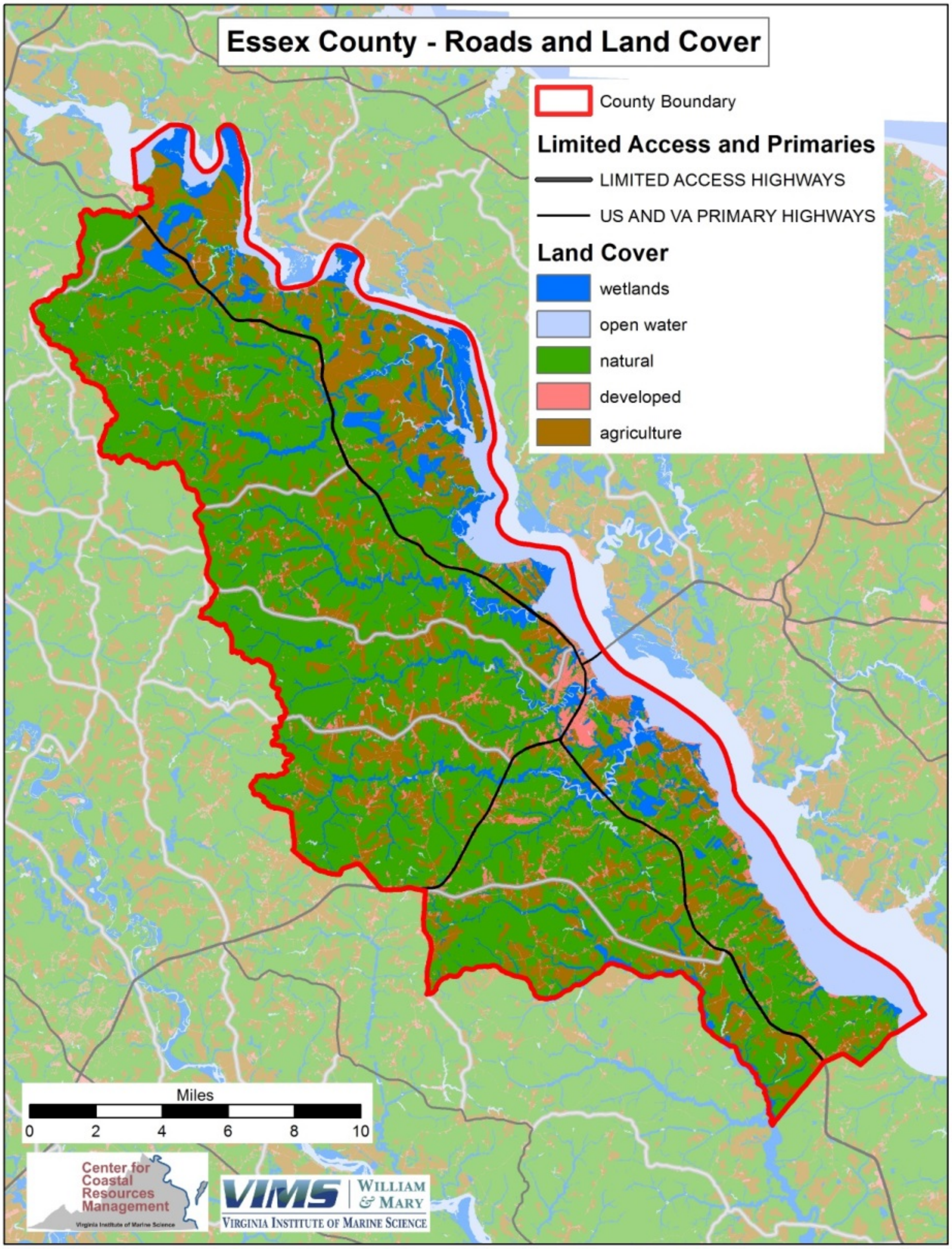
Middlesex			entire county			ditch drainage
	acres	P lb/ac/yr	P lb/yr	acres	P lb/ac/yr	P lb/yr
open water	36,496	0	0	224	0	0
developed	8,067	0.8	6,454	5,107	0.8	4,086
natural	53,717	0.1	5,372	32,730	0.1	3,273
agriculture	15,450	1.87	28,892	9,062	1.87	16,946
wetlands	5,962	0.08	477	3,196	0.08	256
total	119,692		**41,195**	50,320		**24,561**

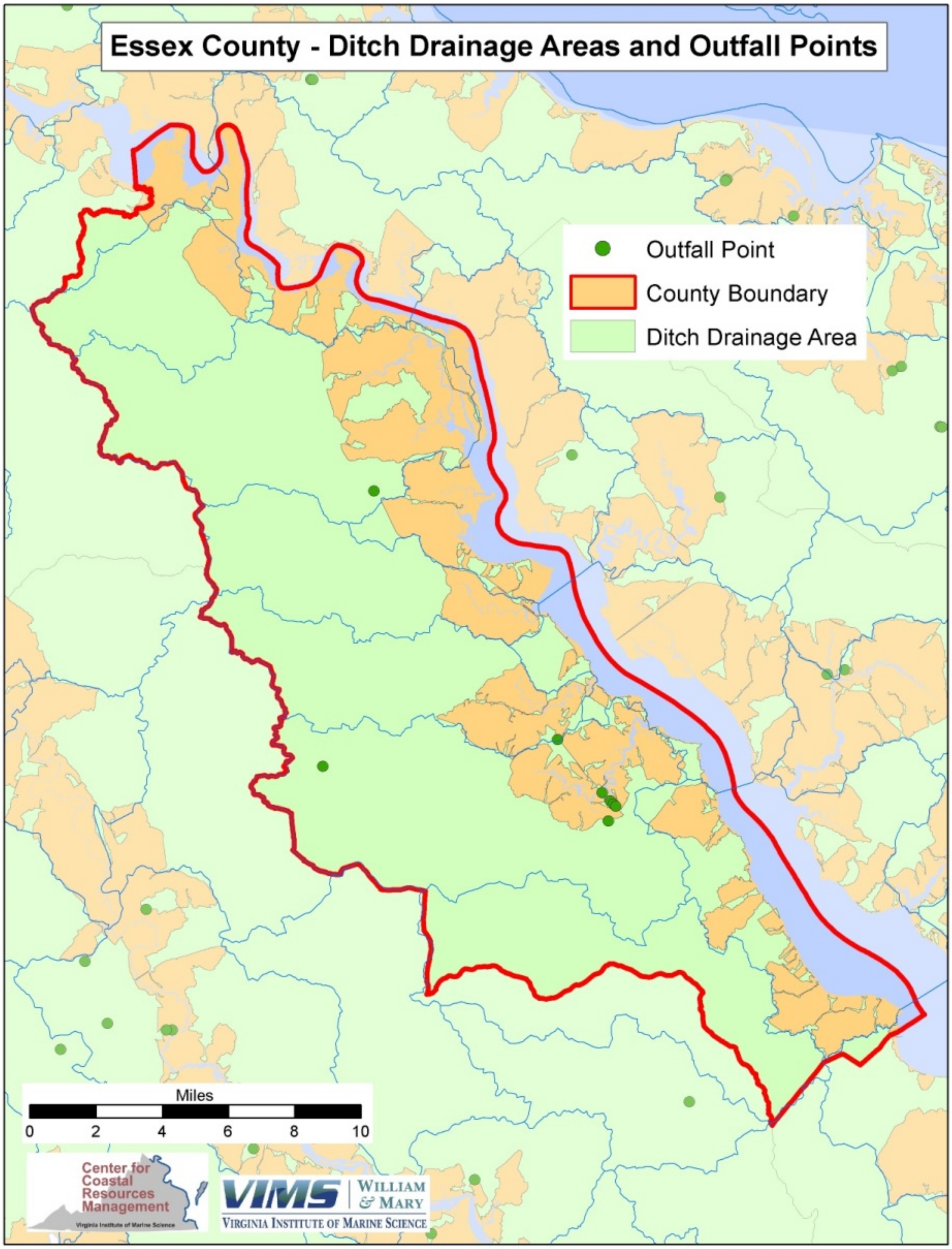
Essex			entire county			ditch drainage
	acres	P lb/ac/yr	P lb/yr	acres	P lb/ac/yr	P lb/yr
open water	18,361	0	0	576	0	0
developed	10,405	0.8	8,324	8,086	0.8	6,469
natural	101,971	0.1	10,197	83,044	0.1	8,304
agriculture	35,264	1.87	65,944	24,346	1.87	45,528
wetlands	17,085	0.08	1,367	8,045	0.08	644
total	183,085		**85,832**	124,097		**60,944**


Land Cover
wetlands
open water
natural
developed
agriculture
Level 6 watershed
Miles
0
10
20
30
40
50
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE



Elevation (feet)
2400
300
100
-320
Level 6 watershed
Miles
0
10
20
30
40
50
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science


Essex County - Roads and Land Cover
County Boundary
Limited Access and Primaries
LIMITED ACCESS HIGHWAYS
US AND VA PRIMARY HIGHWAYS
Land Cover
wetlands
open water
natural
developed
agriculture
Miles
0
2
4
6
8
10
Center for Coastal Resources Management
VIMS
William & Mary
Virginia Institute of Marine Science


Essex County - Ditch Drainage Areas and Outfall Points
Outfall Point
County Boundary
Ditch Drainage Area
Miles
0
2
4
6
8
10
Center for Coastal Resources Management
VIMS
William & Mary
Virginia Institute of Marine Science

Appendix 6. Background Research for Subcommittee 1: Targeted ditch management

This involves identifying ditches that are adjacent to croplands and potentially suitable for modifications that would make the ditch an effective BMP for nutrient and sediment in runoff. Assessment of the concept was conducted in King & Queen and Essex counties.

i. FINDINGS

The ditch BMP approach is under active development in the Bay region. It is not yet credited for application in the WIPs for the Bay TMDL, but the process for determining a credit is underway.

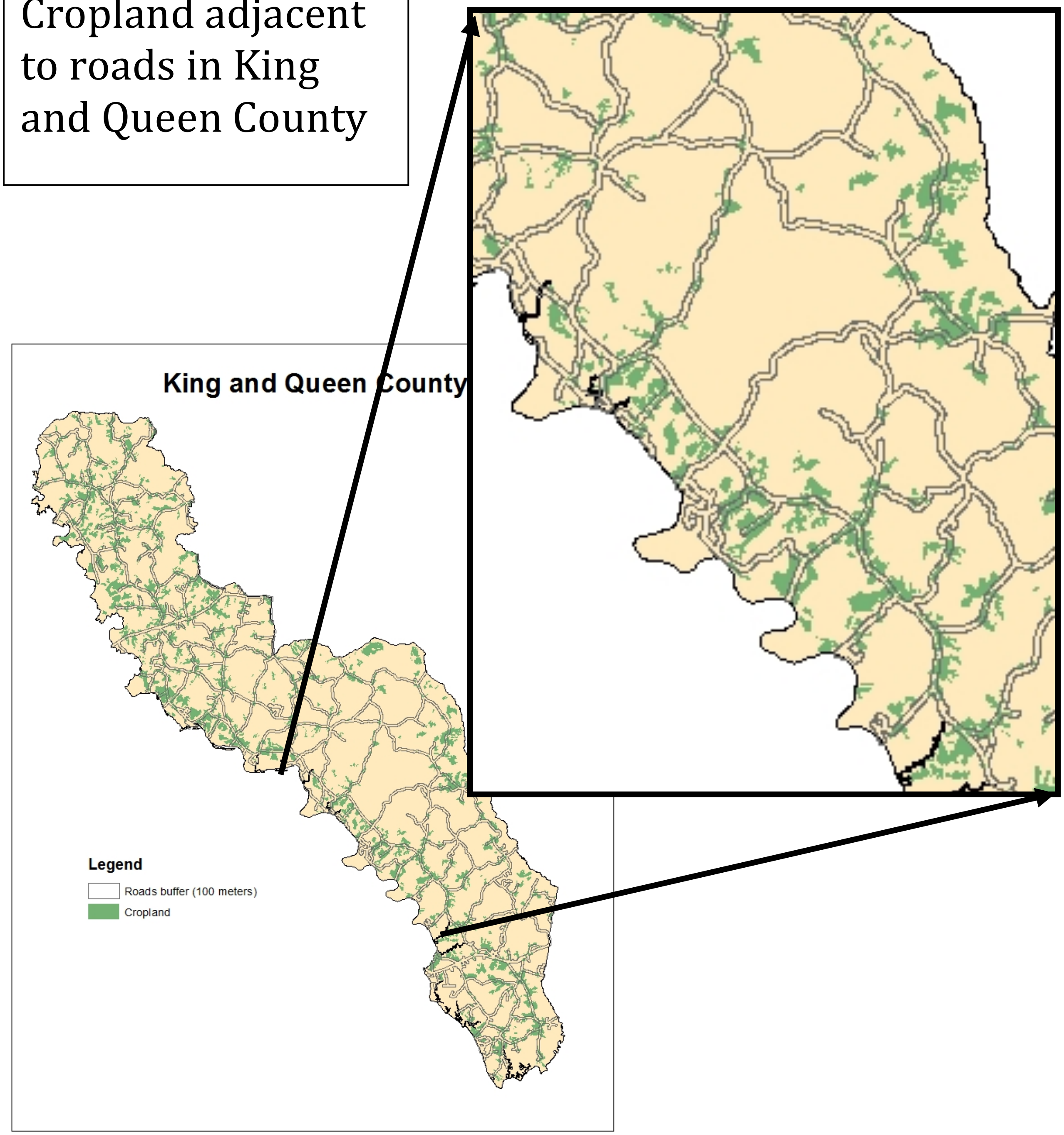
As demonstrated in the following figures, mapping suitable sites, and developing some priorities based on potential loads delivered from field runoff is possible using current landcover and topographic information with storm water models.

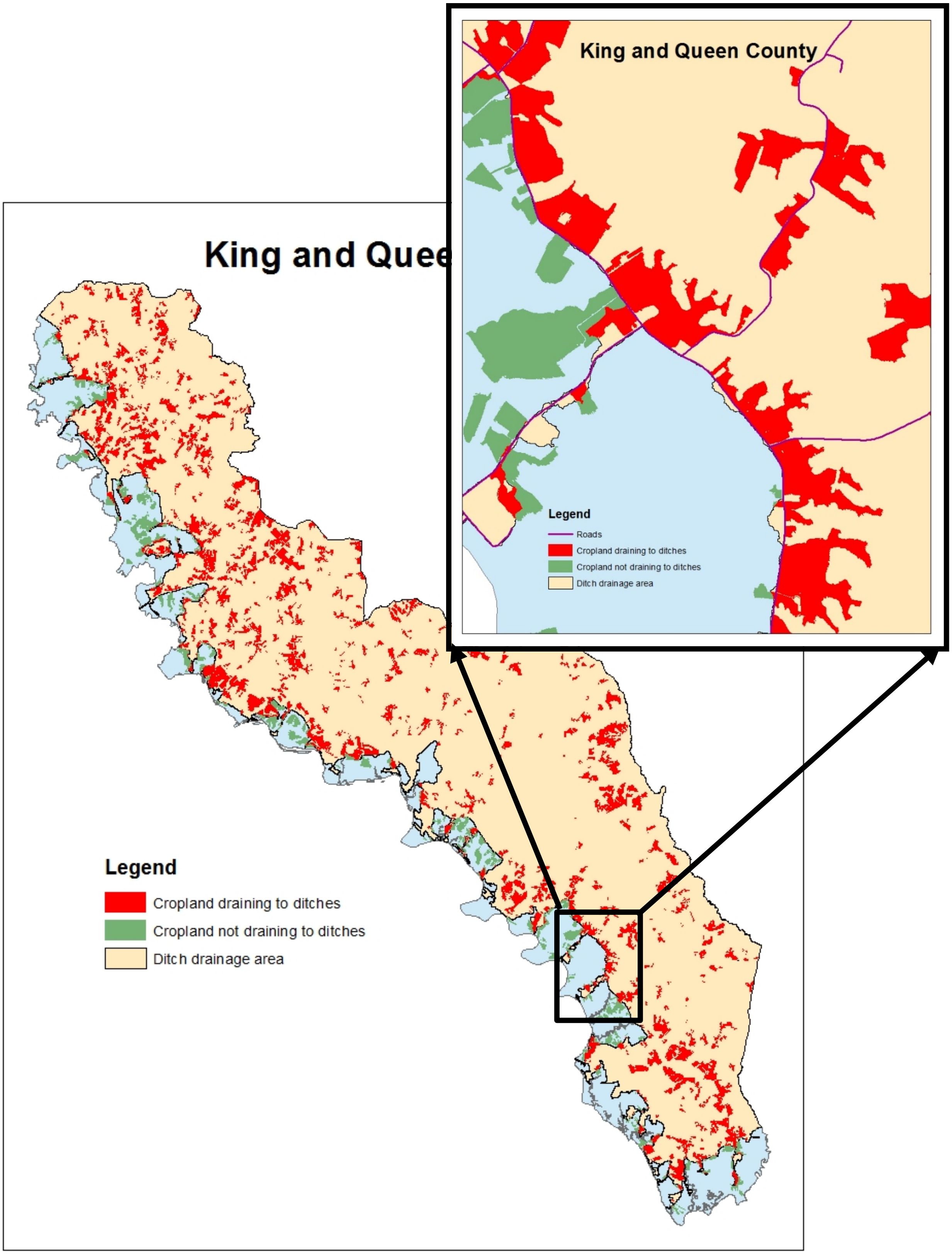
Issues for application of the ditch BMP approach will be site ownership and long term maintenance responsibility.

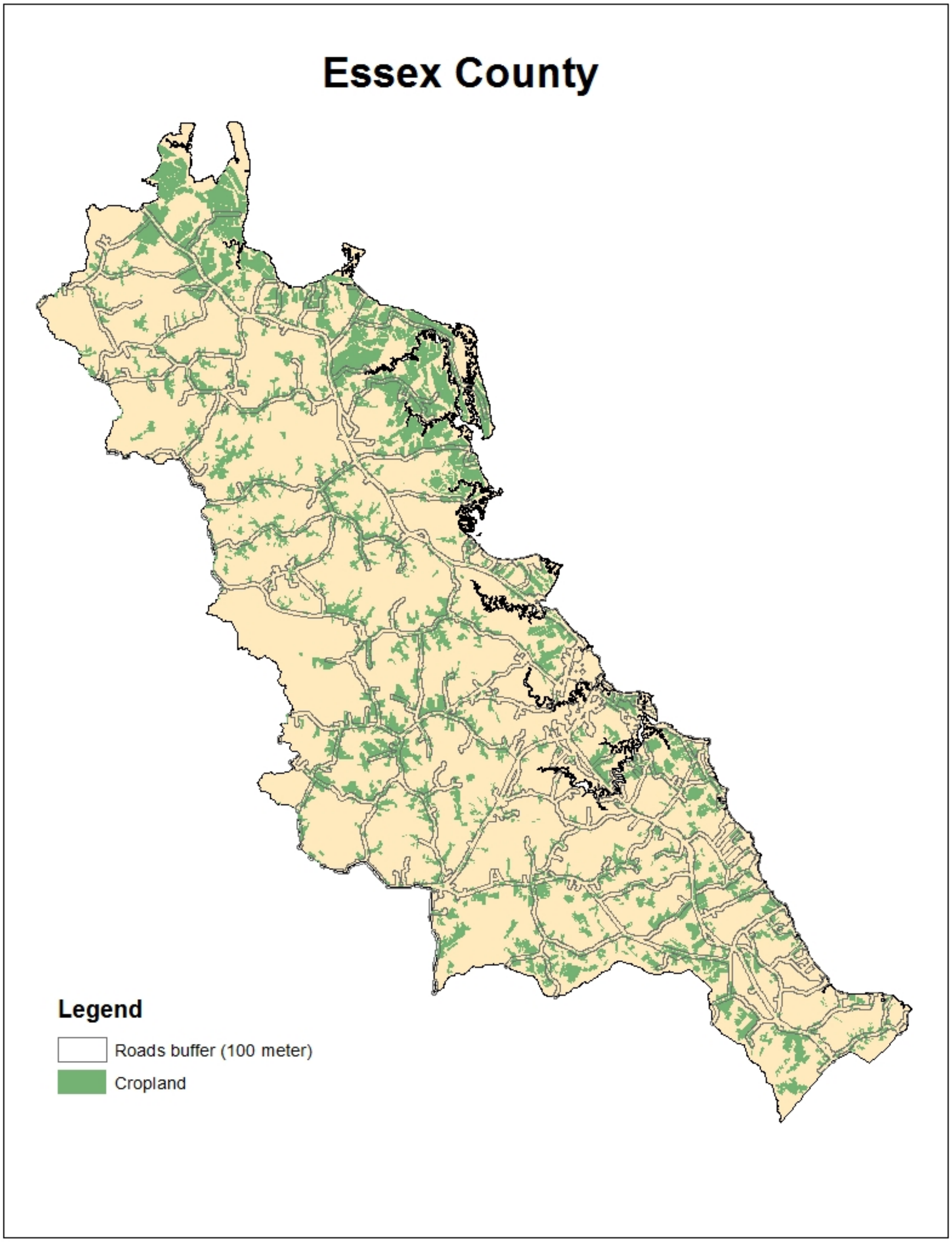
Ditches in proximity to croplands in King and Queen and Essex counties.

King & Queen		
cropland	28,792.5 acres	
flow to ditches	23,507.3 acres	81.6%
within 100m of road	7,181.1 acres	24.9%
Essex		
cropland	34,063.4 acres	
flow to ditches	23,228.7 acres	68.2%
within 100m of road	7,465.9 acres	21.9%

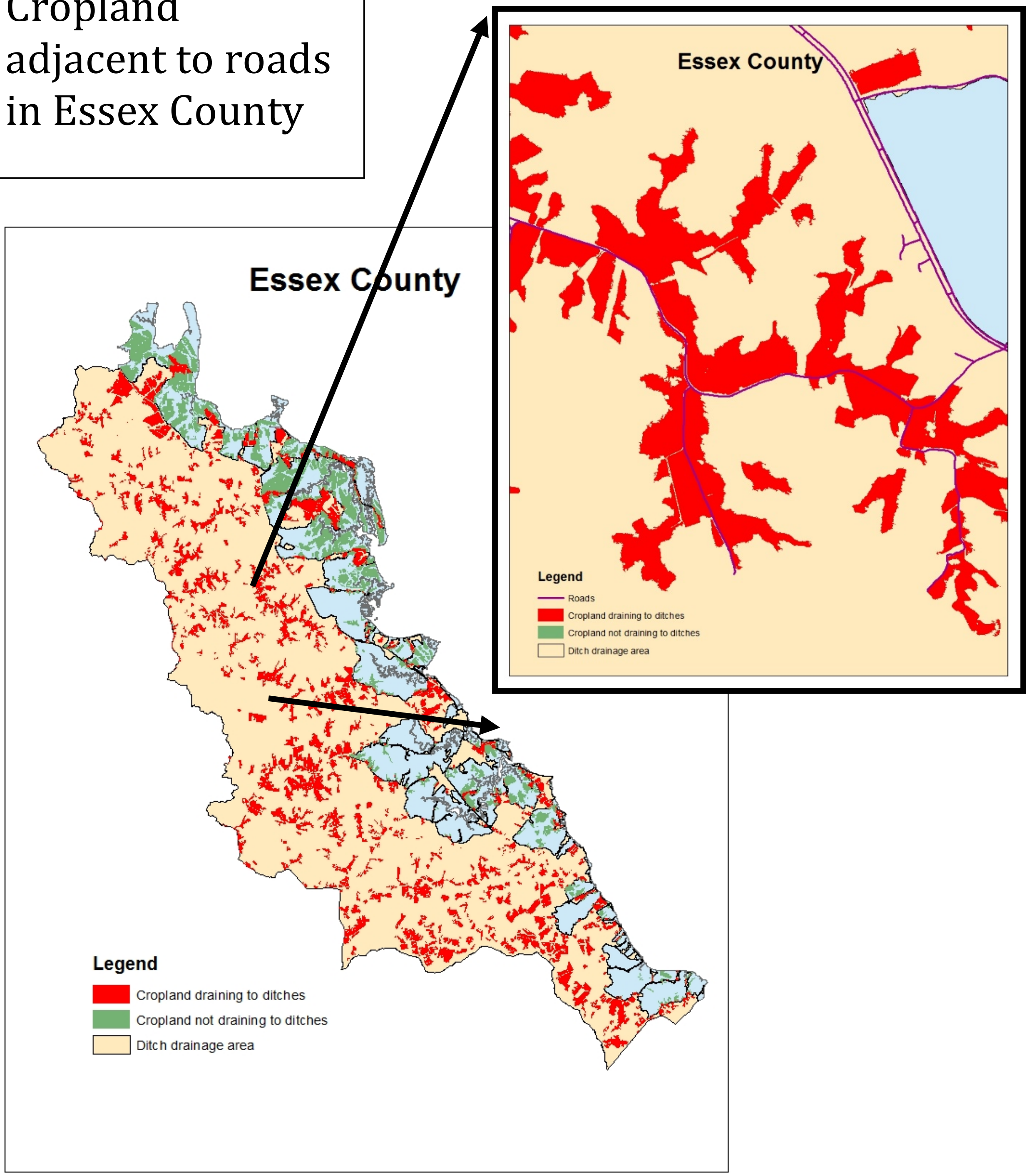
Cropland adjacent to roads in King and Queen County



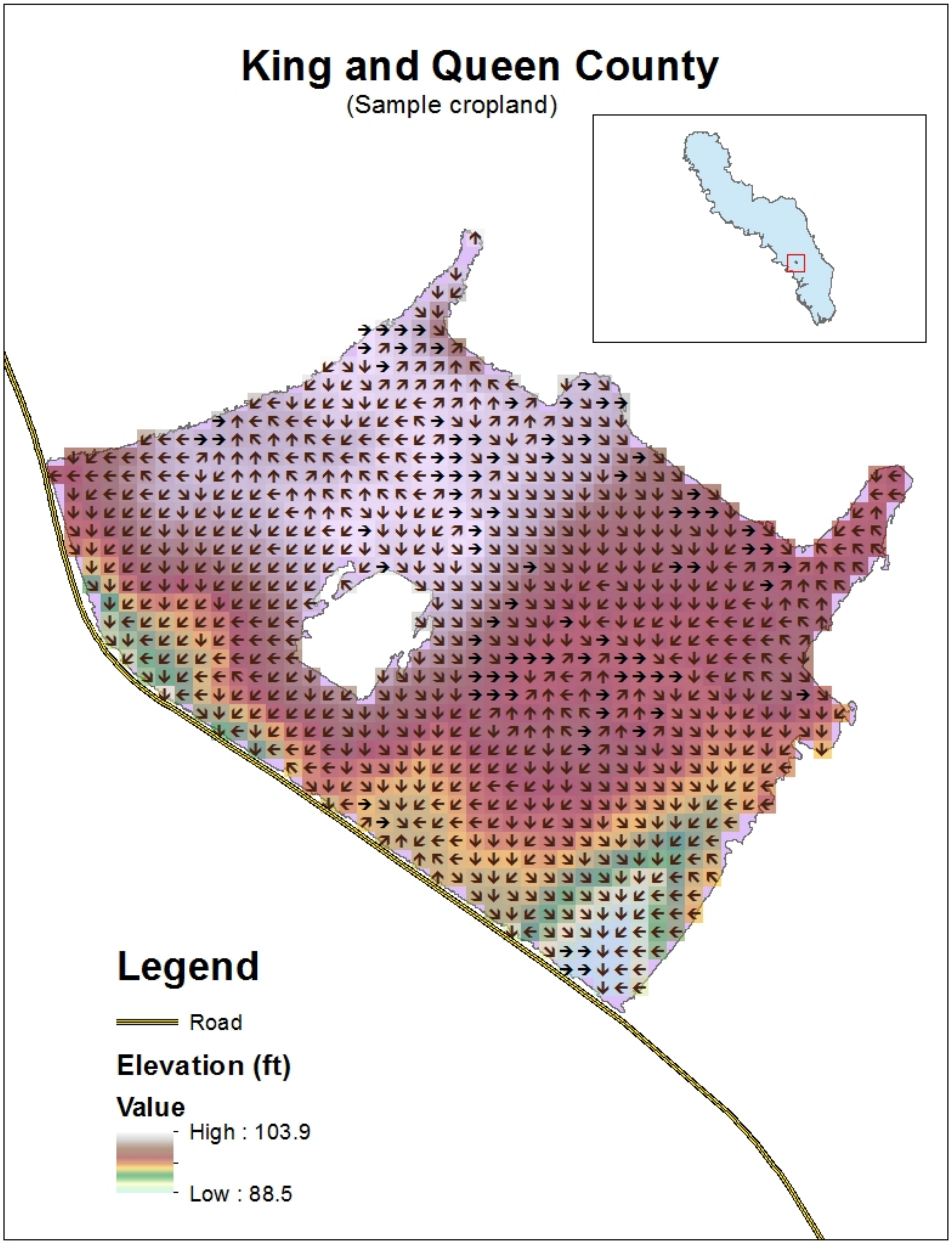

King and Quee
Legend
Cropland draining to ditches
Cropland not draining to ditches
Ditch drainage area
King and Queen County
Legend
Roads
Cropland draining to ditches
Cropland not draining to ditches
Ditch drainage area


Essex County
Legend
Roads buffer (100 meter)
Cropland

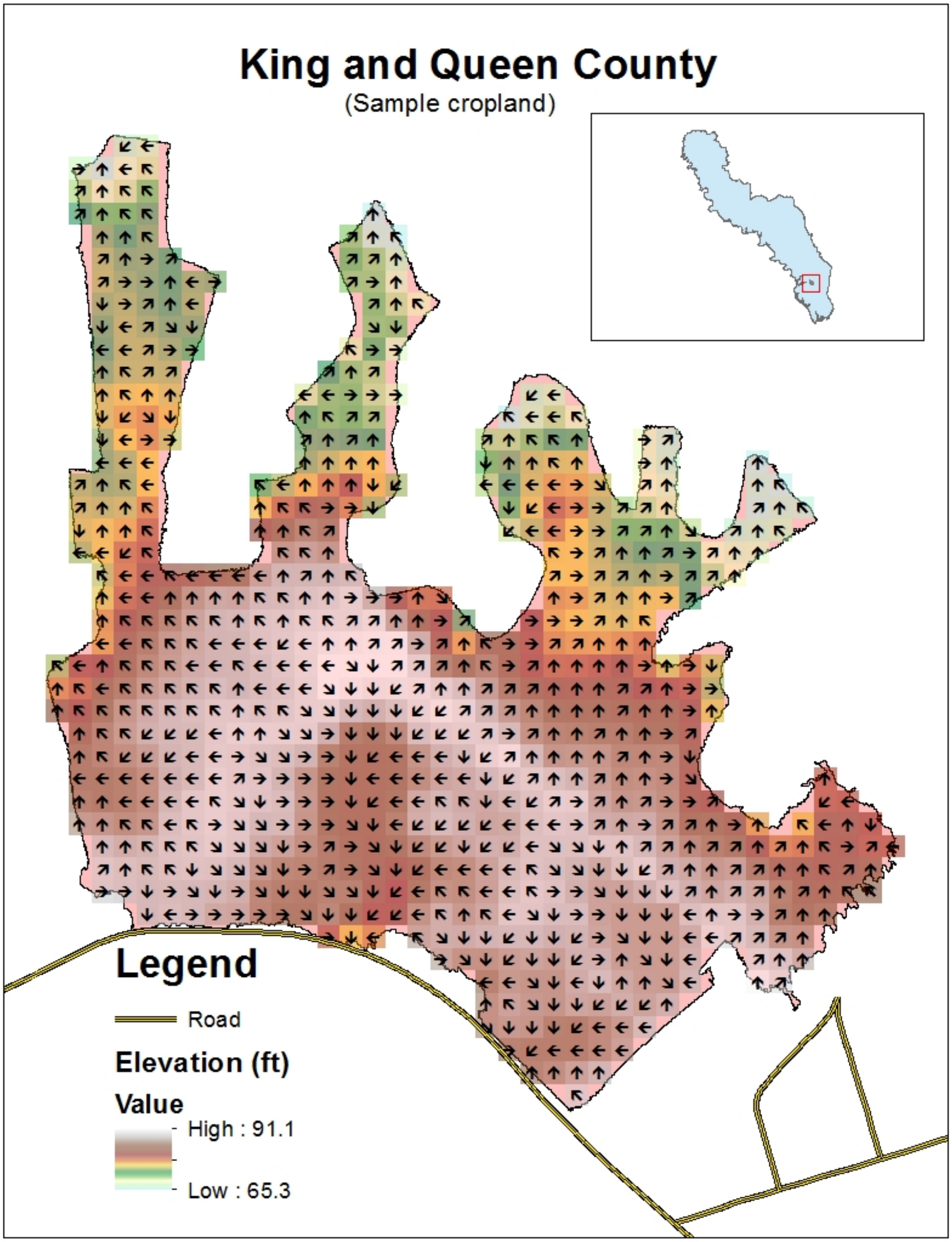
Cropland adjacent to roads in Essex County



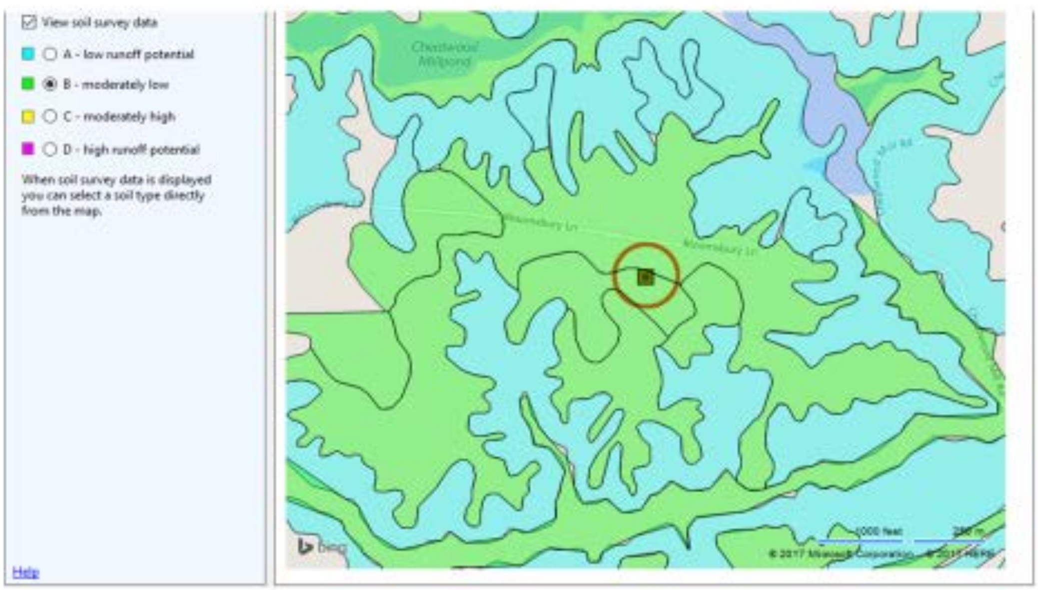
Estimating surface flow paths based on lidar data.



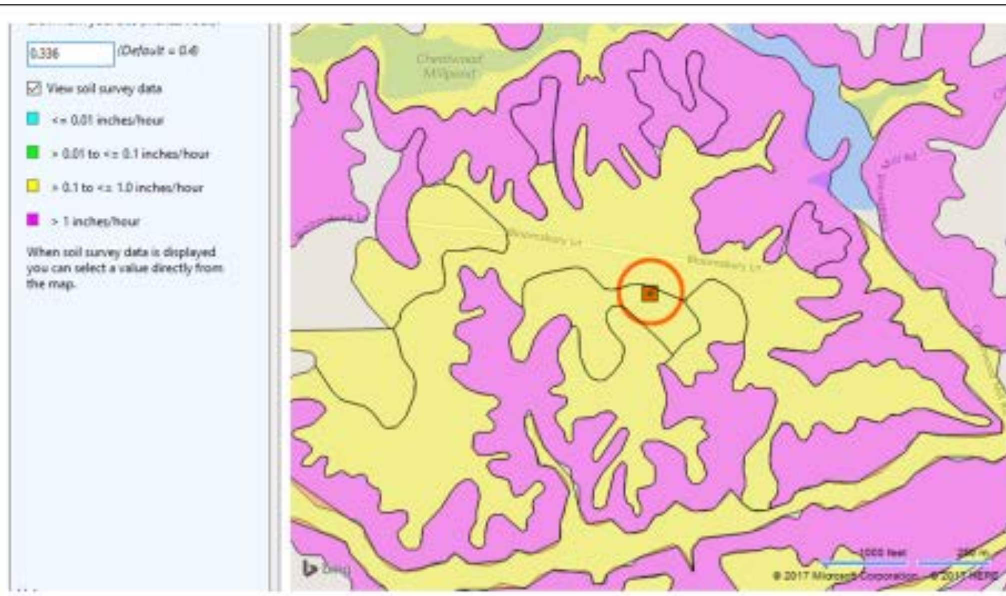
Estimating surface flow paths based on lidar data.



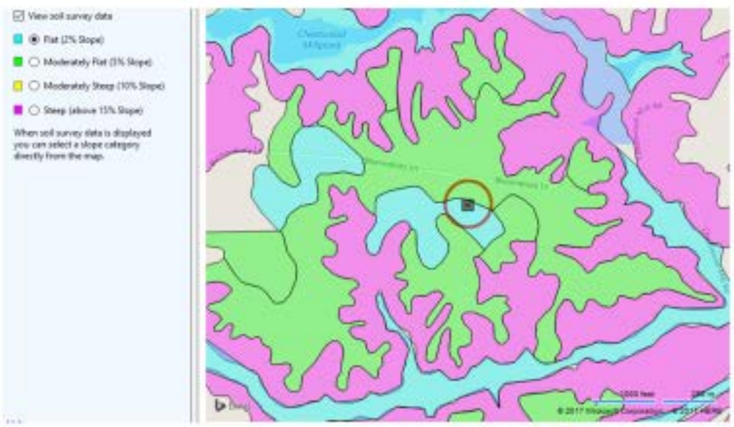
Essex County Cropland 1 Soil Type



Essex County Cropland 1 Soil Drainage

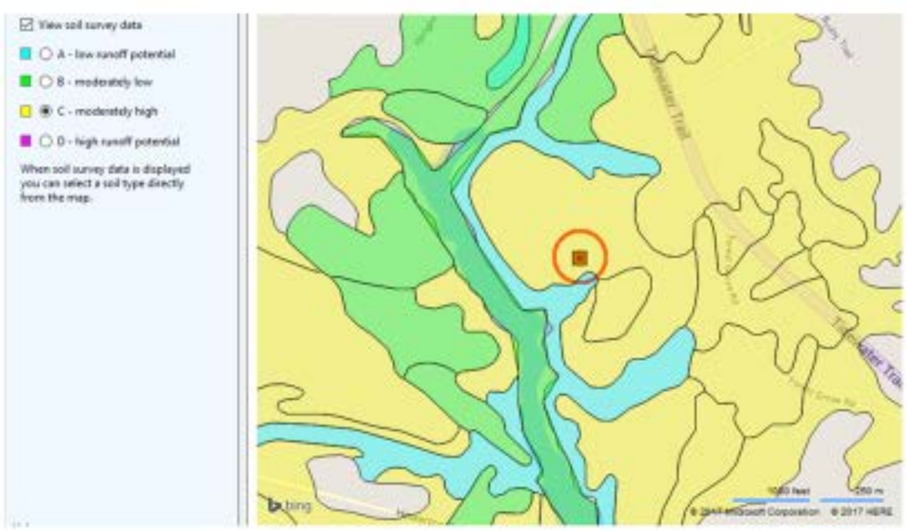


Essex County Cropland 1 Topography

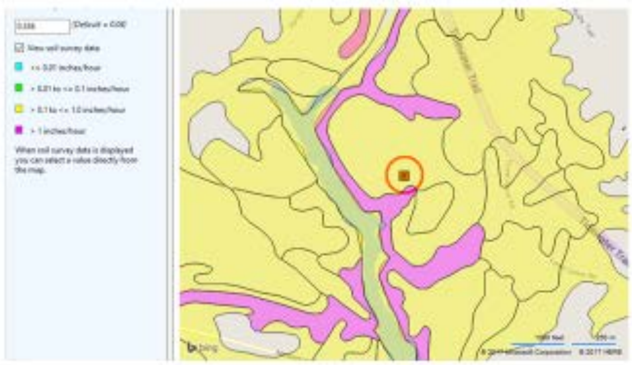


- Though the indicated area is between two slopes, the difference is minimal
  - Soil type and drainage has moderately low runoff potential

Essex County Cropland 2 Soil Type

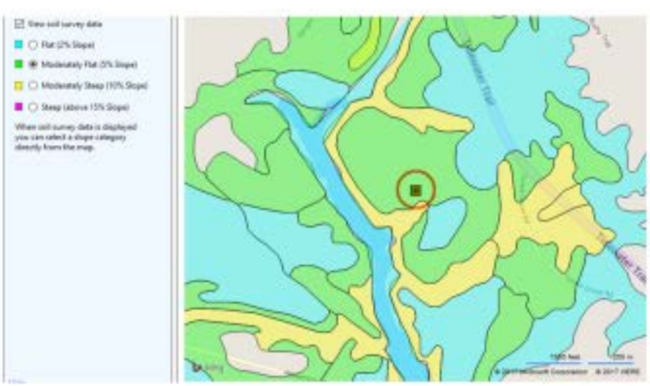


Essex County Cropland 2 Soil Drainage



- The pink area, indicating high drainage rates, is marshland
- The cropland in question has moderately low runoff that is likely to drain into the marsh

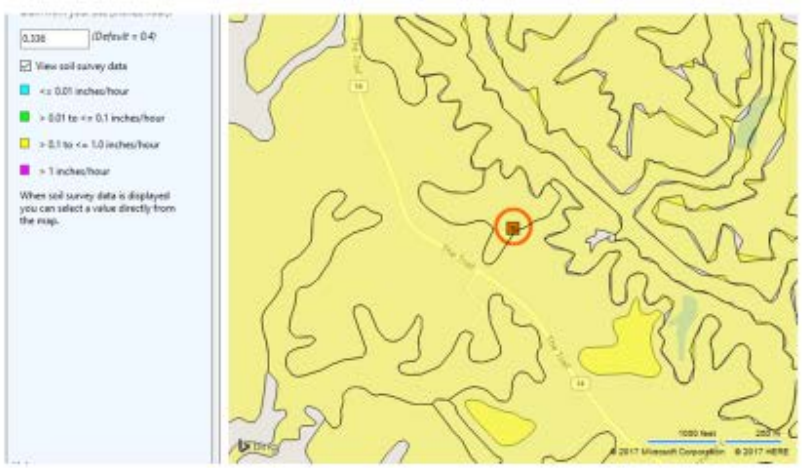
Essex County Cropland 2 Topography



The cropland is moderately flat and then slopes down into the marshland

King and Queen County Cropland 1 Soil Type

King and Queen County Cropland 1 Soil Drainage



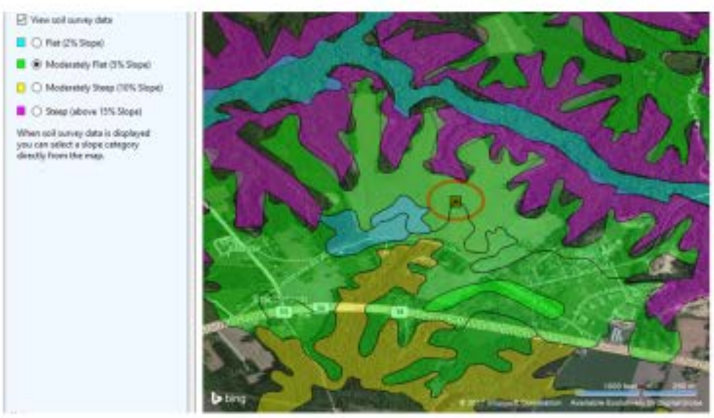
King and Queen County Cropland 1 Topography

- Low runoff and relatively high drainage
- The steep area to the right of the cropland is sloped down into marshland

King and Queen County Cropland 2 Soil Type

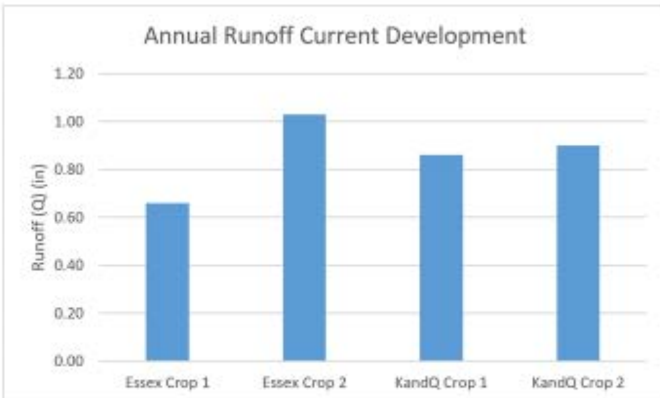
King and Queen County Cropland 2 Soil Drainage

King and Queen County Cropland 2 Topography



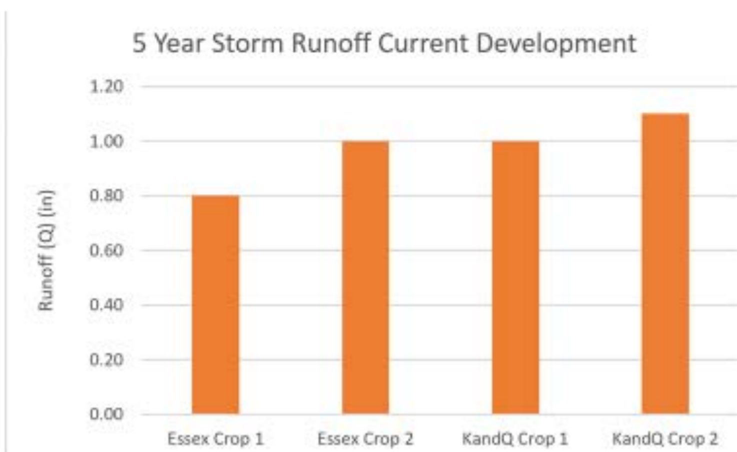
- Cropland 2 is also edged by a marshland for drainage

Essex/King and Queen County Annual Runoff

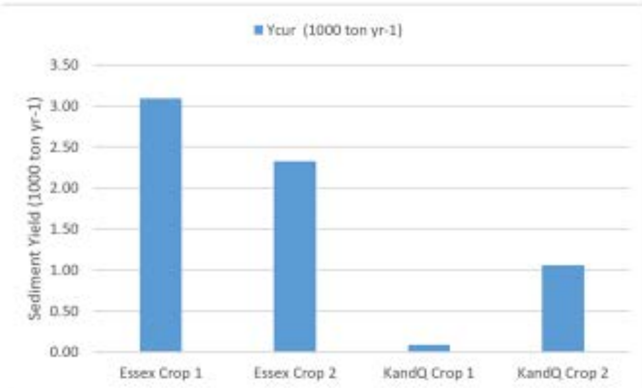


- The second Essex cropland has the highest runoff potential as supported by both the graph and the previous map

Essex/King and Queen County 5 Year Storm Runoff

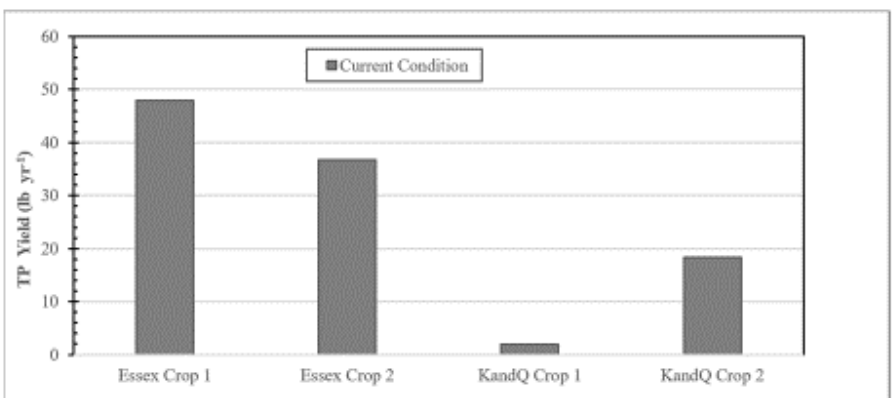


Essex/King and Queen County Annual Sediment Yield



- King and Queen County Cropland 1 has the least amount of sediment yield as there are two steep sides on the perimeter of the cropland

Essex/King and Queen County Annual Phosphorous Yield



Appendix 7. Environmental Impact Bonds

What is an Environmental Impact Bond?

An innovative financing tool that uses **a Pay for Success** approach to provide up-front capital from private investors for environmental projects, either to pilot a new approach whose performance is viewed as uncertain or to scale up a solution that has been tested on a small scale.

CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

EIB

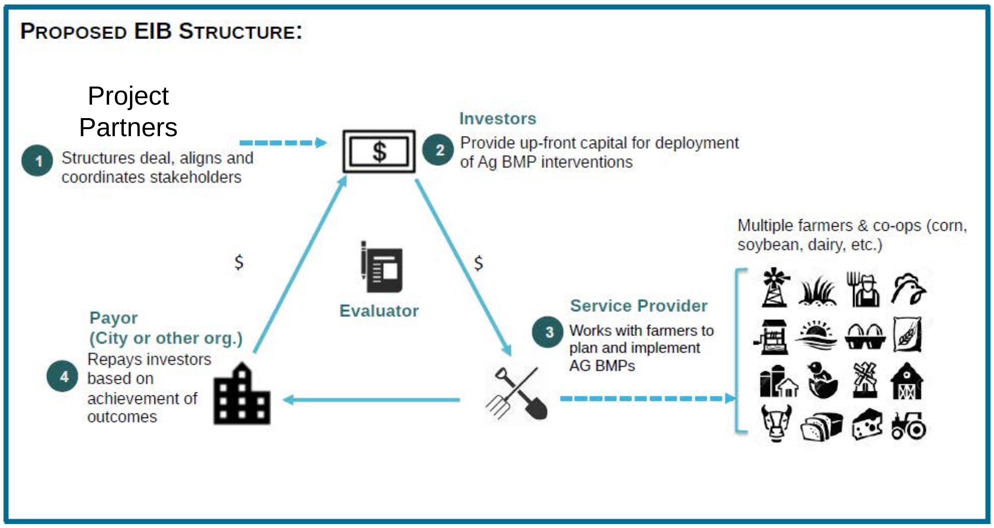
2017 USDA – CIG

Pennsylvania "Offset Partnerships": Bringing Pay for Success Models to Agricultural Conservation and Stormwater Compliance

- Partners: Quantified Ventures, Red Barn, RETTEW, Land O'Lakes
- Lancaster and/or York County municipalities

CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

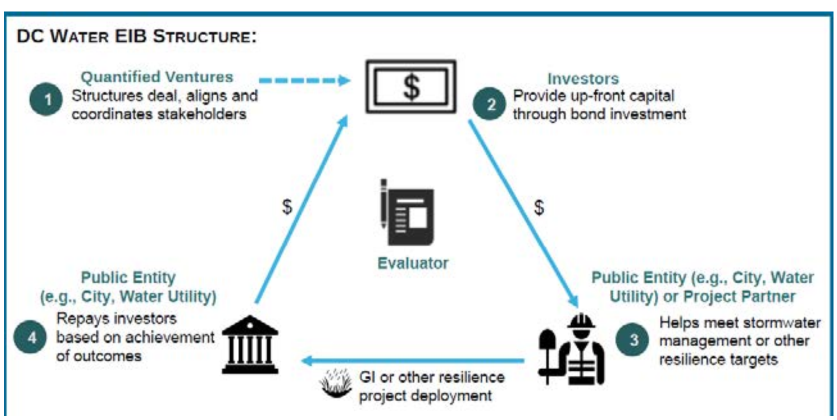
EIB



CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

EIB

CBF and QV seeking 4 local governments to partner on EIB project on stormwater



CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

EIB

To find out more:

- Webinars:
  - Thursday September 14 at 1 pm
  - Thursday September 21 at 1 pm

Contact John Campagna: jcampagna@cbf.org

CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

EIB

Watershed Investment Partnerships

Forest Service's Conservation Finance Team

9/6/2017

Forest Service Conservation Finance

The Forest Service Conservation Finance Team's mission is to increase and expand available finance for Forest Service restoration, conservation, and stewardship objectives across all lands through partnerships with the conservation finance sector

VALUING ECOSYSTEM SERVICES

- New financial resources
- Engaging non-traditional stakeholders
- Incorporating new tools

Conservation Finance Overview

- Two categories
  - Investments with no direct or immediate financial return/profit expected
  - Investments with a financial return/profit expected
- Underlying belief: It is possible to align environmental, social, and economic returns – the "triple bottom line"

Players and Drivers

- Players
  - Socially responsible investors
  - Impact investors
  - Fund managers
  - Philanthropic organizations, NGOs, etc.
- Drivers
  - Concern over climate change
  - Concern over gaps in funding for ecosystems
  - Wealth transfer to millennials and women
  - Access to info on corporate impacts
  - Value-based consumer decisions
  - Market performance!

Forest Service Engagement in Conservation Finance Space

Watershed Investment Partnerships

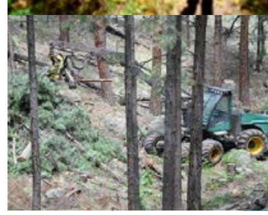
- Reduce wildfire risk and post-fire flood impacts
- Provide urban areas with clean drinking water
- Reduce capital outlays to update infrastructure
- Meet sustainability goals of water-dependent companies

Source Water Protection

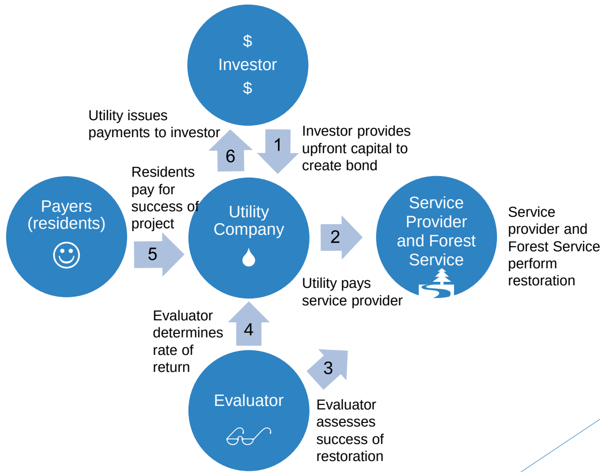
- Forest restoration across urban-rural continuum can:
  - Reduce infrastructure expenses to provide clean drinking water
  - Produce co-benefits and support local jobs
  - Reduce wildfire/flooding risk
  - Meet CSR goals
- The Forest Service manages 20% of our nation's water supply on 193 million acres of land

Municipal Utility Green Performance Bond for Source Water Protection

The objective of the partnership is to structure a bond whose revenues fund forest-based, cross-boundary watershed improvement activities for social, ecological, and economic benefits.



Example Bond



Landscape Criteria

- FS priority/capacity
- Water risks
- Socio-economic/utility conditions

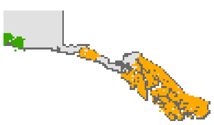
Pathways for Identifying Landscapes

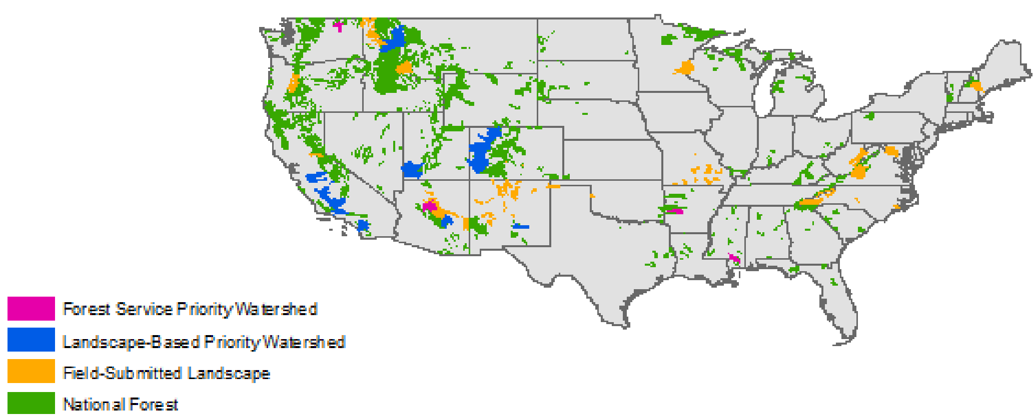
1. Mapping
   - Forest Service priority areas analysis
   - Landscape- and state-based analysis

2. Scoping: Field-submitted landscapes

3. Partner-identified landscapes

Identified Potential Landscapes

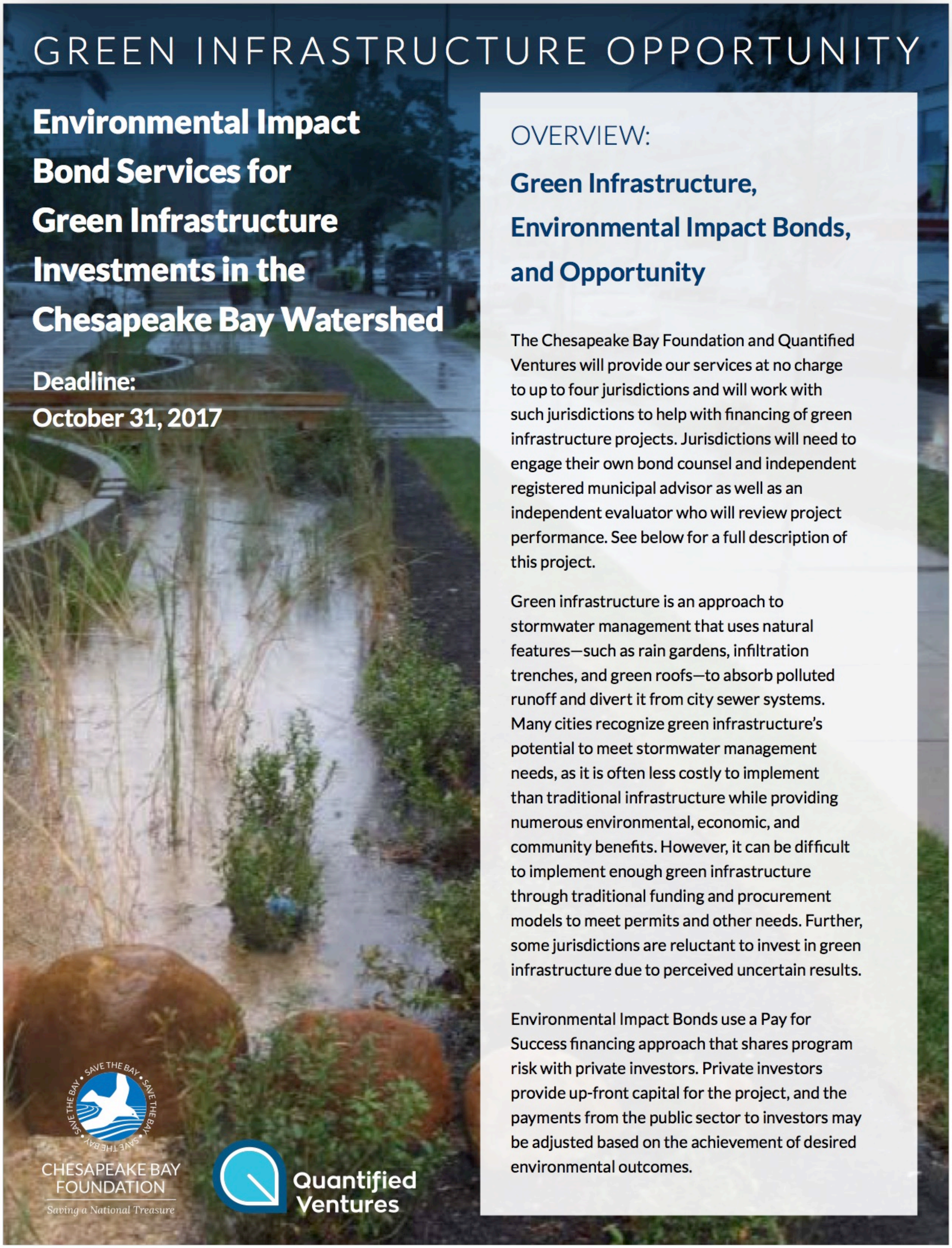




Current Status

- TOP: Ouachita NF, UWC NF, Pisgah NF
- Additional Scoping: Willamette NF, Mark Twain NF, and Sam Houston NF
- Next Steps: Utility conversations, NF conversations

Chesapeake Bay Foundation Bonds



GREEN INFRASTRUCTURE OPPORTUNITY

Environmental Impact Bond Services for Green Infrastructure Investments in the Chesapeake Bay Watershed

Deadline:
October 31, 2017

OVERVIEW:

Green Infrastructure, Environmental Impact Bonds, and Opportunity

The Chesapeake Bay Foundation and Quantified Ventures will provide our services at no charge to up to four jurisdictions and will work with such jurisdictions to help with financing of green infrastructure projects. Jurisdictions will need to engage their own bond counsel and independent registered municipal advisor as well as an independent evaluator who will review project performance. See below for a full description of this project.

Green infrastructure is an approach to stormwater management that uses natural features—such as rain gardens, infiltration trenches, and green roofs—to absorb polluted runoff and divert it from city sewer systems. Many cities recognize green infrastructure's potential to meet stormwater management needs, as it is often less costly to implement than traditional infrastructure while providing numerous environmental, economic, and community benefits. However, it can be difficult to implement enough green infrastructure through traditional funding and procurement models to meet permits and other needs. Further, some jurisdictions are reluctant to invest in green infrastructure due to perceived uncertain results.

Environmental Impact Bonds use a Pay for Success financing approach that shares program risk with private investors. Private investors provide up-front capital for the project, and the payments from the public sector to investors may be adjusted based on the achievement of desired environmental outcomes.

CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

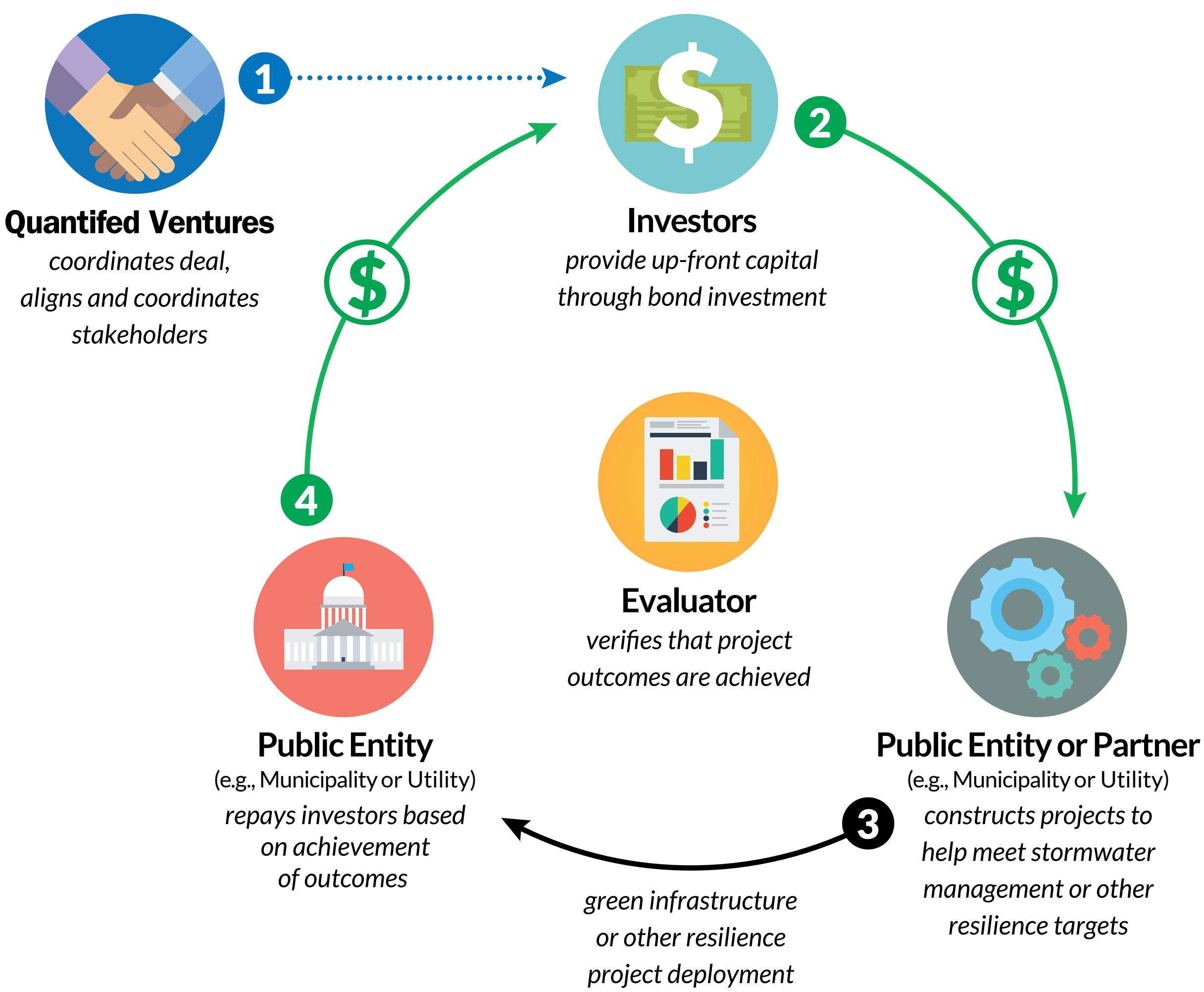
Quantified Ventures

The Opportunity for your Jurisdiction

Environmental Impact Bonds are a flexible mechanism that can be tailored to align investors' and jurisdictions' goals of deploying the most green infrastructure practices possible in a cost-effective manner.

In this kind of financing:

1. Investors' returns are linked to green infrastructure performance. Better results equal higher returns, lower performance results in lower returns.
2. Environmental Impact Bonds work within exisitng procurement processes. Environmental Impact Bonds can be used within traditional (design, bid, build) models or innovative full delivery (design-build) procurement, and fund projects on public and/or private land.
3. Environmental Impact Bonds can be structured as bonds (general obligation or revenue) or a loan.
4. Environmental Impact Bonds can be structured to fit municipalities' finances. Institutional and local investors finance innovative green practices to meet sustainability and community investment goals. We will help municipal advisors identify investors.
5. Additional performance metrics can be included. Additional criteria such as local job and business creation, flood control, and climate resiliency can be part of the evaluation.



DC Water

*Quantified Ventures worked with DC Water, which issued the first-ever Environmental Impact Bond in September 2016. Like many cities, Washington, D.C., had green infrastructure plans to meet its EPA consent decree, but was concerned about whether green infrastructure would deliver sufficient stormwater management benefits. With the Environmental Impact Bond, DC Water pays interest at a fixed rate, with three performance outcomes—**underperform** (investors receive principal and interest but pay a risk sharing payment to DC Water), **outperform** (DC Water pays investors principal and interest plus an outcome payment), and **as expected** (investors receive principal and interest but no additional payments are made by either party).*

SITUATION:
Green Infrastructure Performance Concerns

- Under consent decree with green infrastructure requirement, but wanted to pilot practices on 20 acres before broader deployment to gather performance data.
- Had projects ready to go, and wanted to draw on outside capital, but was concerned about taking on debt given the performance risk of green infrastructure.

SOLUTION:
DC Water Issues $25 Million Bond

- DC Water will pay for outcomes (performance of green infrastructure in terms of stormwater runoff). Different performance benchmarks set with help of QV and monitored by third-party evaluator.
- Goldman Sachs and Calvert Foundation invested $25 million and agreed to share in the risk of nonperformance. Other than that, the Environmental Impact Bond looks like a normal bond for DC Water.

The Chesapeake Bay Foundation and Quantified Ventures

The Chesapeake Bay Foundation is a non-profit working with communities across the Chesapeake Bay watershed to save the Bay. CBF has helped several local jurisdictions undertake some of the work required under their municipal stormwater permits. Quantified Ventures is a leader in Pay for Success and recently worked with DC Water in its issuance of the nation's first Environmental Impact Bond for stormwater management through green infrastructure practices.

CBF and QV will select up to four municipalities within the Chesapeake watershed to work with us at no charge (except for the cost of their own advisors), to develop green infrastructure practices through funding with Environmental Impact Bonds or loans. Specifically, we will:

1. Help each municipality structure and participate in a green infrastructure program involving an Environmental Impact Bond/loan, in service to the locality's municipal stormwater permit or related needs;
2. Work closely with the municipality and its financial advisors, new investors, and regulators to accommodate local issues; and,
3. Demonstrate links to local job creation and other ancillary benefits (flood control, climate adaptation, neighborhood enhancement), as appropriate.

CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

Quantified Ventures

FACT SHEET: DC Water Environmental Impact Bond

Today, the DC Water and Sewer Authority (DC Water) and its investors, Goldman Sachs and Calvert Foundation, have announced the nation's first Environmental Impact Bond (EIB), an innovative bond to fund the construction of green infrastructure to manage stormwater runoff and improve the District's water quality.

The proceeds of the EIB will be used to construct green infrastructure practices designed to mimic natural processes to absorb and slow surges of stormwater during periods of heavy rainfall, ultimately reducing the incidence and volume of combined sewer overflows (CSOs) that pollute the District's waterways. CSOs occur when the volume of wet weather flows exceeds the capacity of the sewer system, resulting in stormwater and sanitary sewer overflows into area watersheds. Currently, approximately two billion gallons of CSOs overflow into the Anacostia and Potomac Rivers and Rock Creek on an annual basis, adversely affecting the water quality of the rivers and tributaries in the region.

CSO reduction has become an increasingly urgent environmental challenge as a result of climate change, which has increased the frequency and severity of intense rainfall events. If the green infrastructure control measures financed by this EIB are successful in managing stormwater runoff, green infrastructure will be validated as an effective climate adaptation tool – enhancing the natural resilience of the District in the face of the adverse impacts of climate change and creating a healthier future for District residents.

The EIB is based on an innovative financing technique whereby the costs of constructing the green infrastructure are paid for by DC Water, but the performance risks of managing stormwater runoff are shared amongst DC Water and the investors. As a result, payments on the EIB may vary based on the proven success of the environmental intervention as measured by a rigorous evaluation.

❖ **Project Overview**

- The proceeds from the EIB will provide the upfront capital needed to construct DC Water's inaugural green infrastructure project in the Rock Creek sewershed (Rock Creek Project A or RC-A).
- RC-A is part of the DC Clean Rivers Project, a $2.6 billion long-term program to control CSOs that pollute the Anacostia River, Potomac River and Rock Creek.
- The green infrastructure practices will be installed primarily in the public right-of-way and include permeable pavement and bioretention facilities (e.g., rain gardens).

- Stormwater runoff is the predominant cause of CSOs, and green infrastructure practices in RC-A are designed to meet the 1.2” Retention Standard for 20 impervious acres.[1]

❖ **Program Evaluation**

- DC Water is conducting a rigorous, three-step program evaluation of the effectiveness of green infrastructure in managing stormwater runoff:
  - Step 1 - Pre-construction monitoring to measure the existing stormwater runoff without green infrastructure.
  - Step 2 - With results from the pre-construction monitoring and DC Water’s green infrastructure design plan for RC-A, DC Water established outcome ranges predicting the expected reduction in stormwater runoff. An independent engineering firm selected by the investors confirmed these ranges.
  - Step 3 - Post-construction monitoring to measure the actual stormwater runoff with green infrastructure.
- By comparing the actual stormwater runoff to the existing stormwater runoff, DC Water will calculate the effectiveness of green infrastructure in Rock Creek Project A as measured by the percentage reduction in stormwater runoff and determine the associated Performance Tier, which may trigger a contingent payment on the EIB.
- An independent validator will confirm the results of the analysis and Performance Tier.

❖ **Performance Tier, Outcome Ranges and Contingent Payment**

- Depending on the effectiveness of GI, a contingent payment may be due at the mandatory tender date:

Performance Tier	Outcome Ranges	Contingent Payment
1	Runoff Reduction > 41.3%	DC Water will make an Outcome Payment to Investors of $3.3 million.
2	18.6% <= Runoff Reduction <= 41.3%	No contingent payment due.
3	Runoff Reduction < 18.6%	Investors will make Risk Share Payment to DC Water of $3.3 million.

- The Outcome Ranges reflect the expectation that a successful project will result in Performance Tier 2 with no contingent payment due by either party.
- If green infrastructure outperforms expectations and the stormwater runoff reduction is greater than 41.3%, then DC Water will make an additional Outcome Payment to the investors for sharing its risk in the Project.

[1] The 1.2” Retention Standard refers to a storm that falls within the current 90th percentile rainfall event in the District, meaning that 90% of storms produce less than or equal to 1.2” of rain. For RC-A, GI practices have been designed to manage the volume of stormwater runoff produced by 1.2” of rain falling on 20 impervious acres in the Rock Creek sewershed.

- If green infrastructure underperforms expectations and the stormwater runoff reduction is less than 18.6%, then the investors will make a Risk Share Payment to DC Water.
- The amount of the contingent payments is identical and based upon the total interest to be paid on the EIB (through the mandatory tender date), and it reflects an equal probability of the project receiving either a Performance Tier 1 or 3 evaluation.

❖ **Principal Benefits of the EIB**

- The EIB allows DC Water to better manage or hedge a portion of the risk associated with green infrastructure.
    - If green infrastructure underperforms expectations, the investor will make a Risk Share Payment back to DC Water allowing DC Water to recoup some of its investment.
- By structuring a contingent payment based upon the effectiveness of green infrastructure, DC Water is focusing on outcomes (reducing stormwater runoff) in addition to outputs (whether the required number of impervious acres of GI is built).
- This demonstration EIB establishes a replicable and scalable approach to financing green infrastructure for other communities across the country that are considering approaches to managing stormwater runoff and the water quality problem of CSOs.

❖ **Co-Benefits of Green Jobs**

- As part of its green infrastructure program, DC Water is also establishing an ambitious local jobs and workforce development program in partnership with the Water Environment Federation.
- Through its Green Jobs Program, DC Water will train and certify District residents to construct, inspect, and maintain green infrastructure facilities.
- DC Water has established a goal to have 51% of the new jobs created by the green infrastructure program filled by certified, District residents.

Appendix

District of Columbia Water and Sewer Authority
Public Utility Subordinate Lien Revenue Bonds Series 2016B
(Environmental Impact Bonds)

Summary of Key Terms and Participants

Par Amount	$25,000,000
Use of Proceeds	Construction of green infrastructure for Rock Creek Project A (RC-A)
Tax Status	Tax-exempt
Bond Structure	Multimodal variable rate bonds, initially issued in a term mode at a fixed rate through the mandatory tender date
Contingent Payment	Payable (if due) at mandatory tender date
Security Pledge	Subordinate lien pledge of Net Revenues
Final Maturity	October 1, 2046
Mandatory Tender	April 1, 2021
Initial Term Rate	3.43%
Investors	Goldman Sachs Urban Investment Group Calvert Foundation
Investors' Counsel	Orrick, Herrington & Sutcliffe LLP
Bond Counsel	Squire Patton Boggs LLP
Financial Advisor	Public Financial Management, Inc.
Technical Advisor	Harvard Kennedy School Government Performance Lab
Pay for Success Transaction Coordinator	Quantified Ventures

Appendix 8. 2016 Va. Acts Ch. 587

VIRGINIA ACTS OF ASSEMBLY -- 2016 SESSION

CHAPTER 587

An Act to amend and reenact § 15.2-2114 of the Code of Virginia, relating to local stormwater utility; waiver of charges where stormwater retained on site.

[S 468]

Approved April 1, 2016

Be it enacted by the General Assembly of Virginia:

1. That § 15.2-2114 of the Code of Virginia is amended and reenacted as follows:

§ 15.2-2114. Regulation of stormwater.

A. Any locality, by ordinance, may establish a utility or enact a system of service charges to support a local stormwater management program consistent with Article 2.3 (§ 62.1-44.15:24 et seq.) of Chapter 3.1 of Title 62.1 or any other state or federal regulation governing stormwater management. Income derived from a utility or system of charges shall be dedicated special revenue, may not exceed the actual costs incurred by a locality operating under the provisions of this section, and may be used only to pay or recover costs for the following:

1. The acquisition, as permitted by § 15.2-1800, of real and personal property, and interest therein, necessary to construct, operate and maintain stormwater control facilities;

2. The cost of administration of such programs;

3. Planning, design, engineering, construction, and debt retirement for new facilities and enlargement or improvement of existing facilities, including the enlargement or improvement of dams, levees, floodwalls, and pump stations, whether publicly or privately owned, that serve to control stormwater;

4. Facility operation and maintenance, including the maintenance of dams, levees, floodwalls, and pump stations, whether publicly or privately owned, that serve to control ~~the~~ stormwater;

5. Monitoring of stormwater control devices and ambient water quality monitoring; ~~and~~

6. *Contracts related to stormwater management, including contracts for the financing, construction, operation, or maintenance of stormwater management facilities, regardless of whether such facilities are located on public or private property and, in the case of private property locations, whether the contract is entered into pursuant to a stormwater management private property program under subsection J or otherwise; and*

7. Other activities consistent with the state or federal regulations or permits governing stormwater management, including, but not limited to, public education, watershed planning, inspection and enforcement activities, and pollution prevention planning and implementation.

B. The charges may be assessed to property owners or occupants, including condominium unit owners or tenants (when the tenant is the party to whom the water and sewer service is billed), and shall be based upon an analysis that demonstrates the rational relationship between the amount charged and the services provided. Prior to adopting such a system, a public hearing shall be held after giving notice as required by charter or by publishing a descriptive notice once a week for two successive weeks prior to adoption in a newspaper with a general circulation in the locality. The second publication shall not be sooner than one calendar week after the first publication. However, prior to adoption of any ordinance pursuant to this section related to the enlargement, improvement, or maintenance of privately owned dams, a locality shall comply with the notice provisions of § 15.2-1427 and hold a public hearing.

C. A locality adopting such a system shall provide for full waivers of charges to the following:

1. A federal, state, or local government, or public entity, that holds a permit to discharge stormwater from a municipal separate storm sewer system~~;~~, except that the waiver of charges shall apply only to property covered by any such permit; and

2. Public roads and street rights-of-way that are owned and maintained by state or local agencies, including property rights-of-way acquired through the acquisitions process.

D. A locality adopting such a system shall provide for full or partial waivers of charges to any person who installs, operates, and maintains a stormwater management facility that achieves a permanent reduction in stormwater flow or pollutant loadings. The locality shall base the amount of the waiver in part on the percentage reduction in stormwater flow or pollutant loadings, or both, from pre-installation to post-installation of the facility. No locality shall provide a waiver to any person who does not obtain a stormwater permit from the Department of Environmental Quality when such permit is required by statute or regulation.

E. A locality adopting such a system may provide for full or partial waivers of charges to cemeteries, property owned or operated by the locality administering the program, and public or private entities that implement or participate in strategies, techniques, or programs that reduce stormwater flow or pollutant loadings, or decrease the cost of maintaining or operating the public stormwater management system.

F. Any locality may issue general obligation bonds or revenue bonds in order to finance the cost of infrastructure and equipment for a stormwater control program. Infrastructure and equipment shall include structural and natural stormwater control systems of all types, including, without limitation, retention basins, sewers, conduits, pipelines, pumping and ventilating stations, and other plants, structures, and real and personal property used for support of the system. The procedure for the issuance of any such general obligation bonds or revenue bonds pursuant to this section shall be in conformity with the procedure for issuance of such bonds as set forth in the Public Finance Act (§ 15.2-2600 et seq.).

G. In the event charges are not paid when due, interest thereon shall at that time accrue at the rate, not to exceed the maximum amount allowed by law, determined by the locality until such time as the overdue payment and interest are paid. Charges and interest may be recovered by the locality by action at law or suit in equity and shall constitute a lien against the property, ranking on a parity with liens for unpaid taxes. The locality may combine the billings for stormwater charges with billings for water or sewer charges, real property tax assessments, or other billings; in such cases, the locality may establish the order in which payments will be applied to the different charges. No locality shall combine its billings with those of another locality or political subdivision, including an authority operating pursuant to Chapter 51 (§ 15.2-5100 et seq.) of Title 15.2, unless such locality or political subdivision has given its consent by duly adopted resolution or ordinance.

H. Any two or more localities may enter into cooperative agreements concerning the management of stormwater.

I. For purposes of implementing waivers pursuant to ~~provision 1 of subsection C~~ *subdivision C 1*, for property where two adjoining localities subject to a revenue sharing agreement each hold municipal separate storm sewer permits, the waiver shall also apply to the property of each locality and of its school board that is accounted for in that locality's municipal separate storm sewer program plan, regardless of whether such property is located within the adjoining locality.

J. Any locality that establishes a system of charges pursuant to this section may establish a public-private partnership program, to be known as a stormwater management private property program, in order to promote cost-effectiveness in reducing excessive stormwater flow or pollutant loadings or in making other stormwater improvements authorized pursuant to this section. A locality that opts to establish a stormwater management private property program pursuant to this subsection shall:

1. Promote awareness of the location, quantity, and timing of reductions or other improvements that it determines appropriate under this program;

2. Seek the voluntary participation of property owners;

3. Accept the participation of property owners on both an individual and a group basis by which multiple owners may collaborate on improvements and allocate among the multiple owners any payments made by the locality;

4. Enter into contracts at its discretion to secure improvements on terms and conditions that the locality deems appropriate, including by making payments to property owners in excess of the value of any applicable waivers pursuant to subsections D and E; and

5. Require appropriate operation and maintenance of the contracted improvements.

K. Any locality that establishes a stormwater management private property program pursuant to subsection J may procure reductions and improvements in accordance with the Public-Private Education Facilities and Infrastructure Act (§ 56-575.1 et seq.) or other means, as appropriate. Subsection J shall not be interpreted to limit the authority of a locality to secure reductions of excessive stormwater flow or pollutant loadings or other stormwater improvements by other means.

Appendix 9. Grant Report, Integrating Agricultural and Urban Pollution Reduction through Targeted Restoration in Talbot County

Trust Fund Final Report
Chesapeake & Atlantic Coastal Bays Trust Fund
Grant # **14-14-1829 TRF09**

Project Title: Integrating Agricultural and Urban Pollution Reduction through Targeted Restoration in Talbot County

Grant Period: November 22, 2013 – June 30, 2016

Reporting Period: November 22, 2013 – June 30, 2016

Grantee: The Nature Conservancy

Project Location: (MD8:) Talbot County – Choptank and Wye River Watersheds

Project Contact:
Name: Amy Jacobs
Address: 114 S. Washington St, Ste. 102
Phone: 443-521-3034
Email: ajacobs@tnc.org

Funding:
Award: $84,219.00
Match: $0
Total: $84,219.00

Recipient of Funds:
Name: The Nature Conservancy, MD/DC Chapter
FIN: 53-0242652
Address: 5410 Grosvenor Lane, Suite 100, Bethesda, MD 20814
Phone: (301) 897-8570 ext 202 (Phone)

Introduction/ Project Goals

The Chesapeake Bay TMDL requires reductions in nitrogen, phosphorus, and sediment pollution from Maryland's Eastern Shore of up to 30% by the year 2025. Counties have been struggling with how to implement the urban and agricultural WIPs because of the high costs that are projected and lack of guidance at the local level on how to identify the best places to implement best management practices (BMPs). County governments tasked with reducing urban loads in rural counties are particularly frustrated because of the high cost of urban retrofits, the limited opportunities within small towns, and concern of the agricultural community of losing additional tillable farmland to water quality practices.

In Talbot County, 60% of the nitrogen load is attributed to agricultural land uses which comprise 56% percent of the land in the county (Figure 1). Talbot County also has 271 miles of county roads, most of which have associated ditches on one or both sides that function to move water from the cropland and road surfaces. These manmade, concentrated flow channels have been found to capture more than 20% of runoff from road surfaces and adjacent hillslopes, acting as high velocity "faucets" that transport water, soil nutrients, and sediment to our waterways during major rainfall events. Recognizing the role of roadside ditches in transporting nutrients and sediment to surface water, and the need to treat runoff from both impervious surfaces (roads) and cropland, local officials had proposed requiring a 50-foot buffer on private property alongside all county road ditches. The proposal met fierce opposition from the agricultural community whose main concern was the loss of land available for crop production that the requirement would impose. Farmers also questioned the water quality benefit of establishing buffers along all county roads because the proposed policy did not consider whether the buffer would perform the targeted water quality function (i.e. if water from agricultural fields would filter through the buffer).

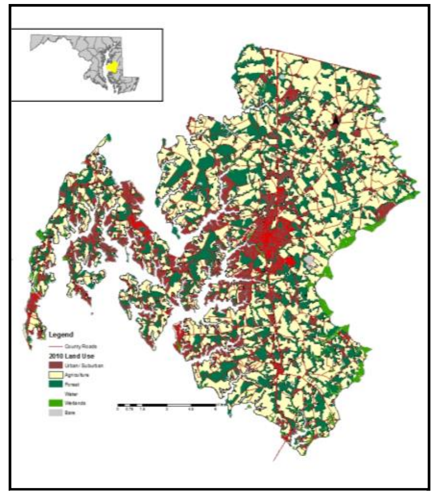


Figure 1. Talbot County land use is dominated by agriculture and contains over 270 miles of roads.

In response to this controversy between the county and the agricultural community, The Nature Conservancy (TNC) and the Chesapeake Bay Foundation (CBF) worked closely with Talbot County to develop the Talbot Ditch Restoration Partnership (TDRP). The goal of the TDRP is to improve water quality in Talbot County and the Chesapeake Bay by reducing nutrient and sediment loads to local waters. Specifically, the TDRP:

- focuses on treating a combination of urban and agricultural sources to minimize costs
- is supported by the local community to identify opportunities that are compatible with existing farm operations and road safety and integrity
- establishes a local project delivery process that readies the community for program expansion and additional investment
- serves as a model for other counties and local governments for how to achieve WIP goals and improve local water quality effectively and efficiently

In collaboration with CBF, Talbot County Department of Public Works, Talbot Country Soil Conservation District and other interested parties, TNC: 1) developed a targeting tool to identify roadside ditch locations that would intercept the greatest nutrient and sediment reductions, 2) implemented a diversity of projects to demonstrate restoration options to landowners, and 3) developed outreach materials and programs to engage local landowners and policy makers. As a direct result of these efforts, Talbot County successfully secured additional funding to implement the TDRP program. This additional funding will retrofit high priority projects identified by the targeting tool and strengthen collaboration between the county roads department and the Soil Conservation District.

Methodology (targeting and monitoring)

The Nature Conservancy worked with Talbot County partners to identify and prioritize opportunities to reduce impacts from roadside ditches along county roadways concurrently with implementing a diversity of demonstration projects. To evaluate water quality benefits, the targeting analysis was linked with the Chesapeake Bay Program's (CBP) regulatory watershed model, which was developed to define Total Maximum Daily Loads (TMDLs) of excess nutrients and sediment protective of the Chesapeake Bay. First, we used high resolution topography data (1 to 2 m horizontal resolution; 15 cm vertical resolution) to identify concentrated flow channels throughout Talbot County that drain to roadside ditches along county roads and to delineate local contributing areas that influence the quantity and quality of surface waters in a channel. Then edge-of-stream delivered loads of TN, TP, and TSS were estimated based on loading rates predicted by the CBP watershed model specific to land use and land cover conditions within the local contributing area. Finally, retention benefits were calculated using bmp efficiencies (Simpson and Weammert, 2009). The fine-scale assessment also provided a framework to incorporate variables representing additional local concerns and priorities such as urban (road) runoff and agricultural runoff, cropland loss, or habitat considerations.

Given the expense of urban storm water retrofits, County partners were especially interested to work with the agricultural sector to identify low-cost opportunities to address TMDL mandates from two sectors at the same location. Ultimately, the targeting effort was aimed to promote more efficient use of the limited resources available for improving water quality and to increase the likelihood that the county Watershed Implementation Plan (WIP) goals will be met. Importantly, credit for pollution reduction from a BMP can be apportioned to both the urban and the agriculture sectors under Maryland's WIP (as confirmed through conversations with Maryland Department of the Environment). Results identified more than 1,000 ditch treatment opportunities along county roads. Based on CBP5.3 loading rates, the average edge-of-stream sediment load to these concentrated flow channels is more than 1,000 lbs per year. Appendix A highlights the top 25 opportunities, which were used a basis by Talbot County Department of Public Works to secure grant funds for implementation of these projects.

Landowner Engagement/ Gaining Public Support

A critical component to the success of this project was building public decision maker and private landowner support for a targeted ditch restoration approach in Talbot County. To accomplish this, we needed to increase the public's understanding of how ditch retrofits can improve water quality and that this is a cost-effective approach. Our outreach strategy focused on 1) gaining support from the local community to implement demonstration projects by showcasing a variety of projects that are compatible with existing farm operations and road safety and integrity and 2) establishing a local project delivery process that readies the community for program expansion and additional investment.

We used multiple media outlets to achieve these goals including:

- A "mobile workshop" on CBF's historic skipjack and at the ditch pilot projects around the county for county council members and their staff. CBF and the participants discussed and reflected on the county's pollution reduction gap, capacity to close it, and opportunities for action. The energy generated around this project as a result of the outreach illustrates the potential to increase momentum for local governments to advance local solutions for clean water.

- A short video that included a key demonstration project at a well-regarded farmer's property (President of Soil Conservation District and member of the Talbot County Farm Bureau) that received significant attention from farmers, citizens and the press. The video is available for viewing at https://vimeo.com/130424563.

- Poster showcasing the process and benefits of a targeted ditch restoration program that was used at the National Estuarine Research Federation Conference and local events (Figure 2).

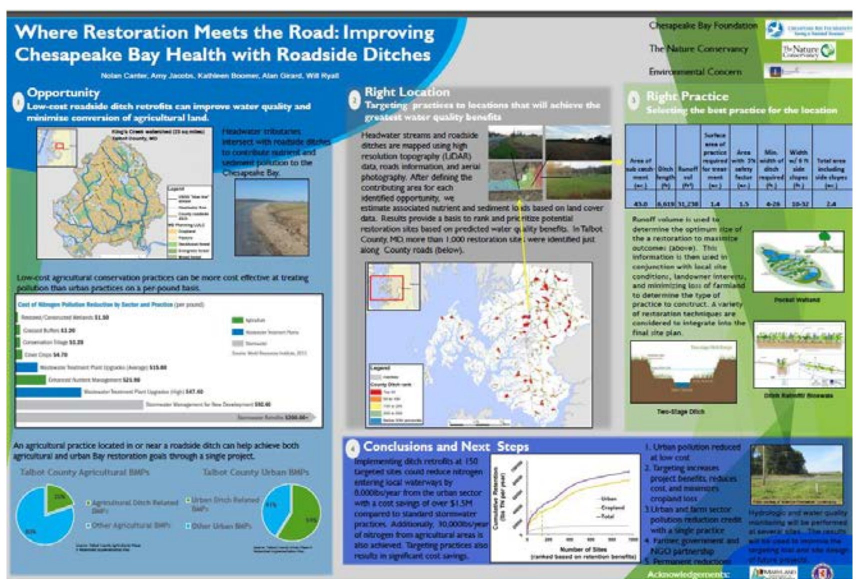


Figure 2. Poster conveying the process and benefits of implementing a targeted ditch restoration program in Talbot County, Maryland.

- CBF the Talbot Preservation Alliance, and the Midshore Riverkeeper Conservancy sponsored the Talbot County Clean Water Forum on April 9, 2015. CBF made a strong case for ditch retrofits to over 100 citizens with a council majority and county staff in attendance. Presentations featured challenges and opportunities for moving forward with clean water in Talbot County, highlighting ditch projects as a key solution. The evening included a presentation of local water quality conditions and trends, followed by a review and discussion of the local pollution sources and practical, cost-effective ways to improve the health of Talbot County's rivers and streams. Please visit http://www.cbf.org/eastern-shore-maryland/events/2015-talbot-county-clean-water-forum for CBF and partner presentations.

Figure 3. Newspaper advertisement in the Star Democrat Newspaper.

- A ribbon cutting ceremony by council featuring a ditch retrofit on county property. This milestone event illustrates a tipping point where the ditch retrofit project transitioned from concept to ownership by the county. The ribbon cutting marked a commitment by county officials to deepen investment in retrofits, using the targeting strategy developed by The Nature Conservancy as a core tool for getting locating potential project sites and driving the installation process.

- Opinion pieces ran in print and online in the *Star Democrat* and the *Talbot Spy*

- CBF initiated three Facebook conversations reaching tens of thousands, generating 206, 166, and 133 likes, and involving exchanges with council members.

- CBF email outreach to supporters, which generated at least 74 emails to the Talbot County Council as well as other personal notes and calls.

- Informative advertisements and flyers (Figure 3).

- An informative fact sheet featured online, which serves a public information clearing-house on ditch retrofits www.cbf.org/ditch

- Educational presentations to the Garden Club of the Eastern Shore, St. Michael's Women's Club, and Bay Hundred Men's Group, some of whose members actively supported efforts to encourage greater investment in ditch retrofits by the county.

- Ditch restoration featured as part of a story on Maryland Farm and Harvest, featuring a local farmer and TNC http://www.mpt.org/programs/farm/farm309/

- Training session for Talbot County Department of Roads staff on the benefits of roadside ditch retrofits and management toward improving water quality.

In concert with the extensive public outreach efforts, TNC and CBF co-led monthly meetings of a workgroup composed of county employees from the Department of Public Works, Department of Planning, and Soil Conservation District, and interested conservation groups including the Midshore Riverkeeper Conservancy, Environmental Concern, and Center for Watershed Protection, and the Maryland Department of Natural Resources. The meetings focused on developing the targeting framework to incorporate input from various stakeholders and identification and implementation of demonstration projects. In combination, these efforts resulted in educated citizens and stakeholders, whose knowledge and interest contributed to a decision by Talbot County to invest in advancing the ditch retrofit program.

In October 2014, a workshop sponsored by the Science and Technical Advisory Committee to the Chesapeake Bay Program, entitled "Re-plumbing the Chesapeake Watershed: Improving Roadside Ditch Management to Meet TMDL goals", was held in Easton, MD. Participants reviewed impacts of roadside ditches on stream hydrology, water quality, and aquatic habitat condition and also discussed a range of practices to mitigate these impacts. Further, participants discussed local, state, and federal policies, or lack thereof, affecting capacity to emplace CBP accredited best management practices. A full report of the workshop can be found through the STAC website (http://www.chesapeake.org/pubs/349_Boomer2016.pdf). The audience of 71 water resource professionals, highway practitioners, scientists, and policy-makers unanimously agreed that roadside ditch management represents a critical but overlooked opportunity to help meet TMDL and habitat goals.

Demonstration Projects

During the initial stakeholder sessions conducted by the CBF and TNC, farmers and landowners stated that they wanted to see examples of the types of projects that could be implemented in Talbot County that would treat agricultural and road runoff. Working with partners and interested landowners identified during our initial outreach, we constructed a variety of projects throughout the county. These projects were selected prior to the completion of the targeting analysis, and while they were not among the highest priorities identified through the targeting analyses, the projects represented ideal opportunities to demonstrate a range of project designs in different landscape settings (Figure 4) and to establish credibility with the farming community.

We worked with the landowner and restoration contractors to develop suitable designs that met the landowner's interests and reduced excess nutrients and sediment. Options considered for the eight sites reported herein included pocket wetlands, two-stage ditches, grass waterways, and bioswales. Estimated retention benefits were revised from the targeting analysis to reflect the actual size and location of the practice and also its retention efficiency. First, watershed contributing areas were recalculated based on the design's inlet and outlet. If needed, the LiDAR data were corrected to reflect field conditions, in particular to capture any culverts significant to surface water movement but unaccounted for in the initial screening. Land use land cover data were updated as well. Similar to the targeting analyses, we estimated excess nutrient and sediment loads and retention benefits using information provided by the CBP and MD Trust Fund. In addition to the practice efficiency benefit, we added the load reductions related to the conversion of land use from agriculture or development to wetland or buffer. Finally, total project costs, including design and construction, were divided by the load reduction to calculate the cost efficiency (dollar per pound TN, TP, and/or TSS reduced) (Table 1.). Detailed descriptions of each site and the associated calculations are provided.

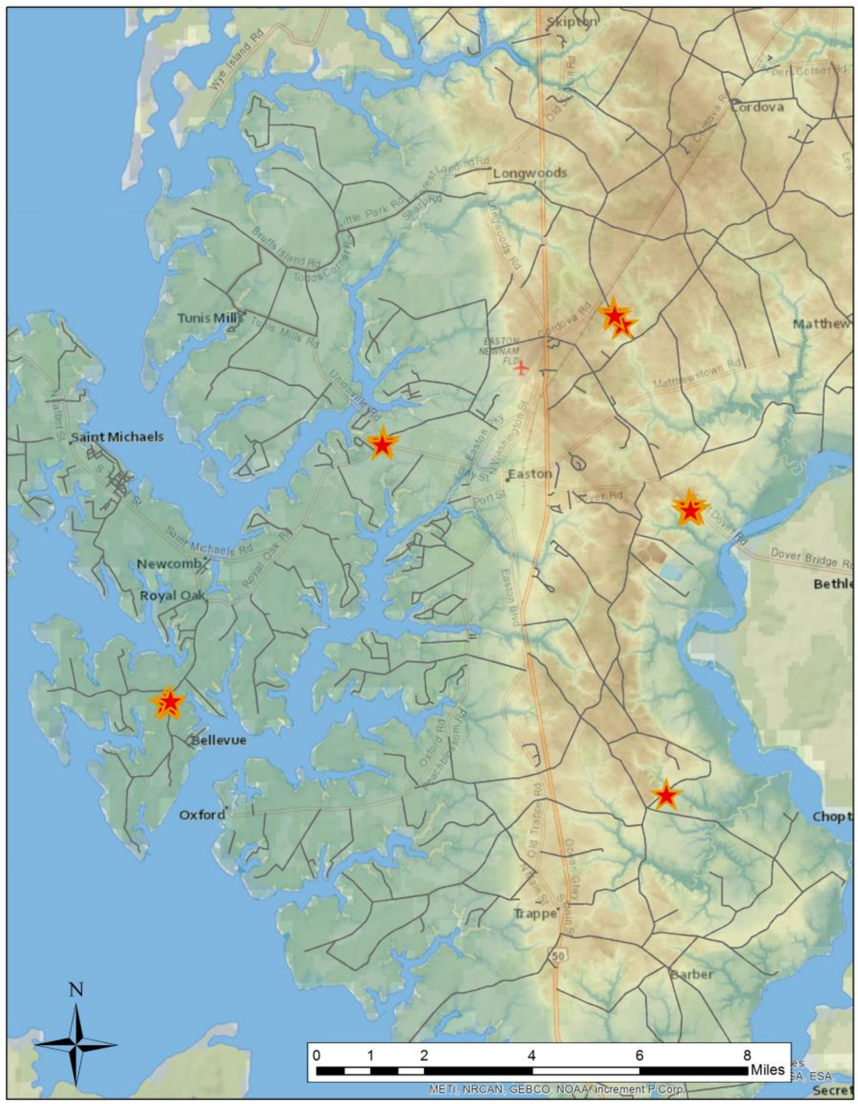


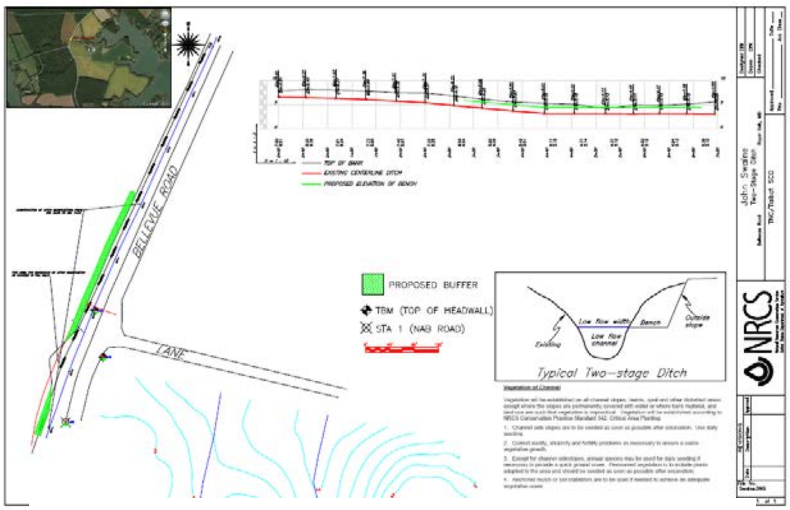
Figure 4. Location of ditch restoration demonstration projects in Talbot County.

Table 1. Talbot Ditch Restoration Demonstration Projects with associated nutrient and sediment reductions.

Project	*Description*	*Lat/Long*	*Cost*	*Est. Nut. Red. lbs/year*	*Deliverables*	*Status*
Bellevue Road	*Ditch retrofit/ 2-stage ditch w/ 5ft. bench and 10ft. grass buffer*	-76.193/ 37.714	TF: $5,125 CBF: $500 Total: $5,625	N: 236 P: 13.4 TSS: 2,062	400ft 2-stage ditch; 0.08ac. buffer	Constructed on March 31, 2015
Bellevue Wetland	Wetland restoration (CP9)	-76.191/ 38.715	TF: $0 CREP $8,500 Total: $8,500	N: 322 P: 14.2 TSS: 2,268	0.3ac. wetland/ 0.4ac. grass buffer	Constructed Nov, 2015
Dover Road Wetland and Waterway	Wetland Restoration, grass waterway	-76.012/ 38.766	TF $1,500 CREP: $10,000 CBF: $500 Total $12,000	N: 336 P: 16.7 TSS: 4,601	0.3ac. wetlands, 0.3ac. grass buffer, 1,786ft. of 30ft width grass waterway	Constructed on April 13, 2015
Unionville Road	Ditch/ swale restoration	-76.117/ 38.784	TFdesign: $7,340 TF: $12,177 Construction: County Construction: $:32,473 Total: $51,990	N: 43 P: 0.5 TSS: 480	0.1 ac. bioswale	Constructed April 2016
Glebe Road	Roadside Ditch retrofit/ 2-stage ditch with 5ft. bench	-76.117/ 38.785	TF: $0 Talbot County DPW: $9,900 ($2,000 design; $7,900 construction) Total:$9,900	N: 16 P: 1.2 TSS: 81.5	400 ft. 2-stage ditch	Ditch retrofit constructed in May 2015
Klondike Wetland	Field Ditch/ wetland restoration	-76.037/ 38.819	TF: $3,250 design; $4,073 construction Total: $7,323	N: 82 P: 4.2 TSS: 773	0.3ac. wetland 0.1 ac. grass buffer	Constructed November 23, 2015
Swaine Field Ditch	2-stage ditch	-76.19/ 38.716	TF: $7,979.50 Total:$7,979.50	N: 118 P: 6.4 TSS: 1,050	400 ft. 2-sided, 2-stage ditch; 0.09 ac. grass buffer	Constructed June 2016
Deep Branch Wetland	Wetland restoration	-76.021/ 38.689	TF: $0 CREP:$8,500 Total: $8,500	N: 59 P: 1.8 TSS: 557	1.4ac. wetland, 0.3ac. buffer	Constructed April 2015

Bellevue Road

Project Description: 2-stage roadside ditch
This project showcased a 2-stage ditch retrofit along a high visibility road in the county. A private landowner and prominent farmer in the county provided the opportunity to implement a demonstration of this new technique. Four hundred feet of a county roadside ditch was enhanced by excavating a 5ft. bench on the field side of the ditch and creating a 4:1 slope to the field. The wetland bench was approximately 6 inches higher than the mean high water of the ditch and amended with topsoil, stabilized with curlex and seeded with oats. A 15ft. grass buffer of cool season grasses was planted on the field side of the ditch A field lead that conveyed significant amount of water during storm events was amended with a small detention basin/wetland in the buffer at the field edge of the ditch to prevent incision into the wetland bench. One-year post restoration, the wetland bench naturally vegetated with a dense population of native wetland plants. The wetland bench will filter water from the adjacent field and road during storm events and thus reduce nutrients and sediment being diverted downstream. The project design was funded by CBF and construction by this grant.

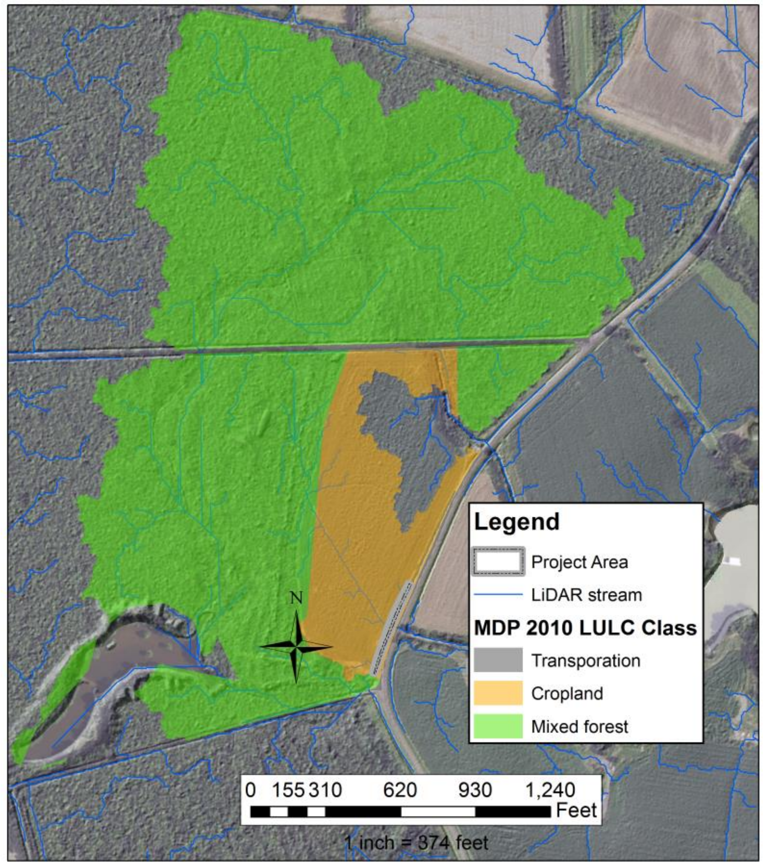


Project design for Bellevue Road 2-stage ditch

Bellevue Road 2-stage roadside ditch during construction in March 2015. A 5ft. wetland bench was created on the field side of the ditch.


Adding top soil to wetland bench and side slope during construction.

Bellevue Road 2-stage roadside ditch post-restoration June 2016.



Contributing drainage area to Bellevue Road and associated landuse.

Table 2a. Land use/ loading rates in drainage area for Bellevue Road

MD Land Use	Acres	TN Loading rate Lb./ac/yr	TN Load lbs/year	TP Loading Rate Lb./ac/yr	TP Load lb/year	Sed Loading Rate Lb./ac/yr	Sed Load lb./year
Roads*	1.0	7.31	7	0.43	0.4	143	139
Cropland**	16.2	18.19	252	0.71	11.1	185.4	1,678
Forest	78.3	1.41	110	0.05	3.6	16.1	1,261
TOTAL	95.5		369		15.1		3,078

*Urban NonReg - impervious developed

** Agriculture - nutrient management hightill without manure

Table 2b. Predicted retention of nitrogen, phosphorus and sediment for 2-stage ditch[a] at Bellevue Road based on loads from Table 2a.

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Wetland	Total Retention (lbs./year)
TN	25%	92	1	93
TP	50%	7.5	0	7.5
Sediment	15%	462	13	475

a – evaluated the "bench" in the 2-stage design as a 0.08ac. wetland

Table 2c. Predicted retention of nitrogen, phosphorus and sediment for grass buffer at Bellevue Road based on loads from Table 2a

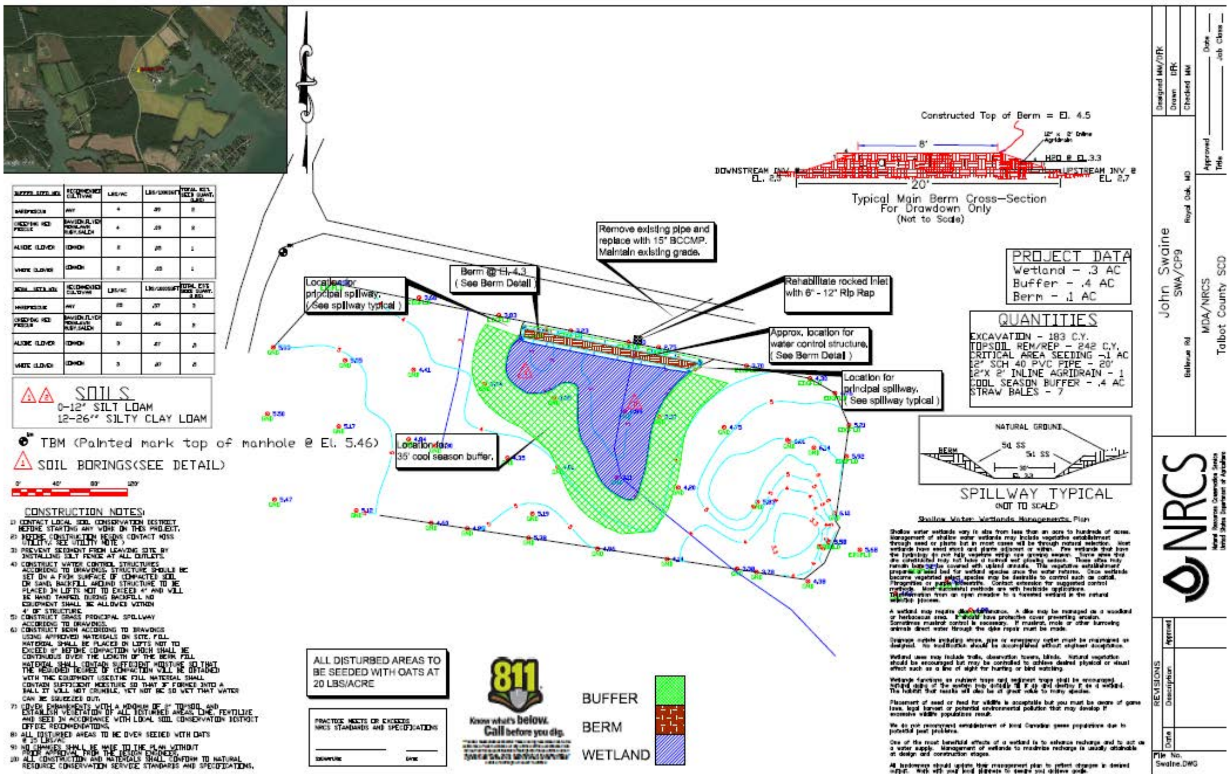
Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Perennial Grass	Total Retention (lbs./year)
TN	39%	144	1	145
TP	39%	5.9	0	5.9
Sediment	52%	1,600	13	1,613

Table 2d. Total predicted retention of nitrogen, phosphorus and sediment for the project and cost efficiency at Bellevue Road

Constituent	Total Project Retention (lbs./year)	Project Cost	Cost/lb. removed
TN	236	$7,980	$34
TP	13.4		$596
TSS	2,062		$4

Bellevue Wetland

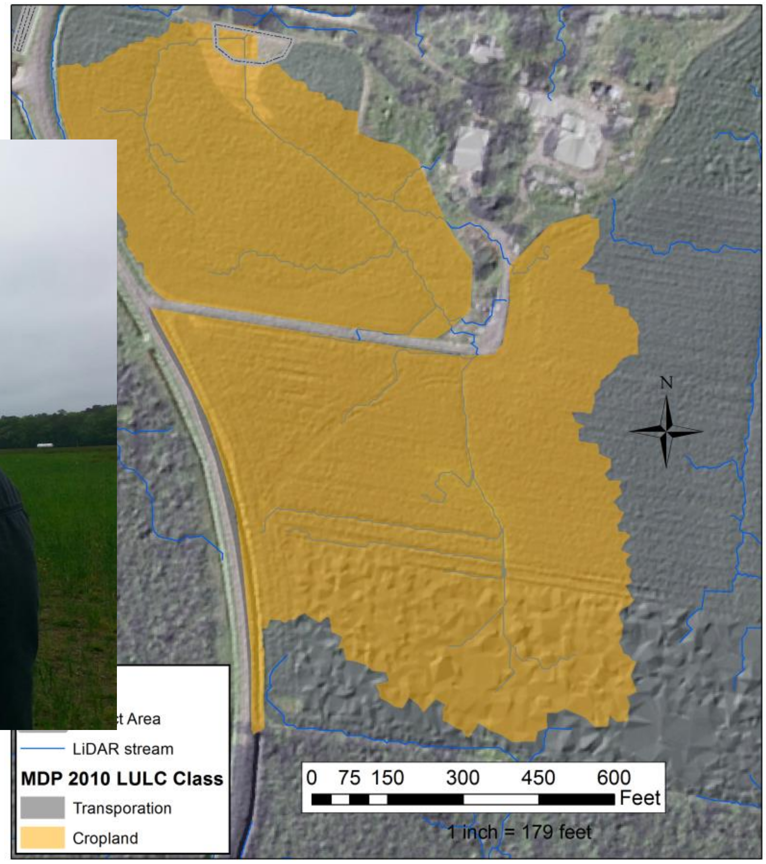
Project Description: Shallow Water Wetland
This project demonstrated the restoration of a shallow water wetland in an area of cropland where the farmer was experiencing consistently low yields. A shallow field lead diverted water from a 23 acre drainage area of mostly cropland and a portion of county road to the wet area and then into a culvert under his driveway eventually leading to the Tred Avon River. A shallow wetland was restored by constructing a berm and installing a water control structure to hold water and create a 0.3 acre wetland with an adjacent 35ft cool season grass buffer. The wetland was seeded with oats for stabilization and will naturally colonize with native vegetation. The wetland will filter nutrients and sediment from the cropland before entering the local waterway. This project design was funded by CBF and construction was funded under the Conservation Reserve Enhancement Program (CREP).



Bellevue Wetland design for a shallow water wetland, CP-29

Bellevue Wetland post construction, May 2016

Bellevue wetland post construction in June 2016 with landowner.



Contributing drainage area to Bellevue Wetland and associated landuse.

Table 3a. Loading Rates in Drainage Area for Bellevue Wetland

MD Land Use	Acres	TN Loading rate Lb./ac/yr	TN Load lbs/year	TP Loading Rate Lb./ac/yr	TP Load lb/year	Sed Loading Rate Lb./ac/yr	Sed Load lb./year
Roads*	2.1	7.31	6	0.43	0.7	143	134
Cropland**	21.3	18.19	387	0.71	15.2	185.4	3,153
TOTAL	23.4		393		15.9		3,287

*Urban NonReg - impervious developed

** Agriculture - nutrient management hightill without manure

Table 3b. Predicted retention of nitrogen, phosphorus and sediment for wetland at Bellevue Wetland based on loads from Table 3a.

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Wetland	Total Retention (lbs./year)
TN	25%	98	5	168
TP	50%	8.0	0	8.0
Sediment	15%	493	51	544

Table 3c. Predicted retention of nitrogen, phosphorus and sediment for grass buffer at Bellevue Wetland based on loads from Table 3a

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Perennial Grass	Total Retention (lbs./year)
TN	39%	153	1	154
TP	39%	6.2	0	6.2
Sediment	52%	1,709	15	1,724

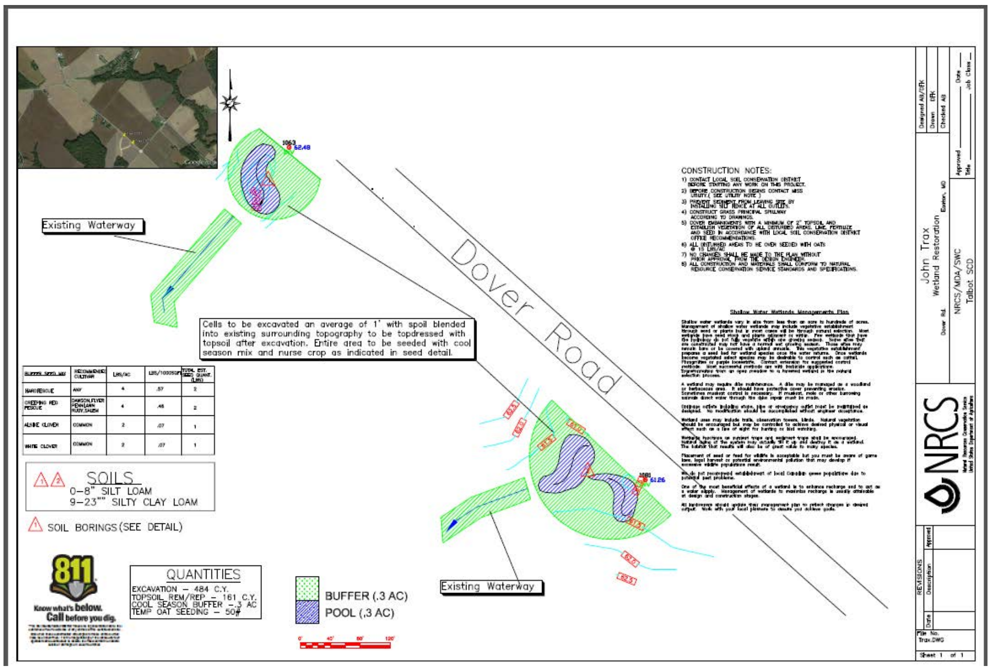
Table 3d. Total predicted retention of nitrogen, phosphorus and sediment for the project and cost efficiency at Bellevue Road

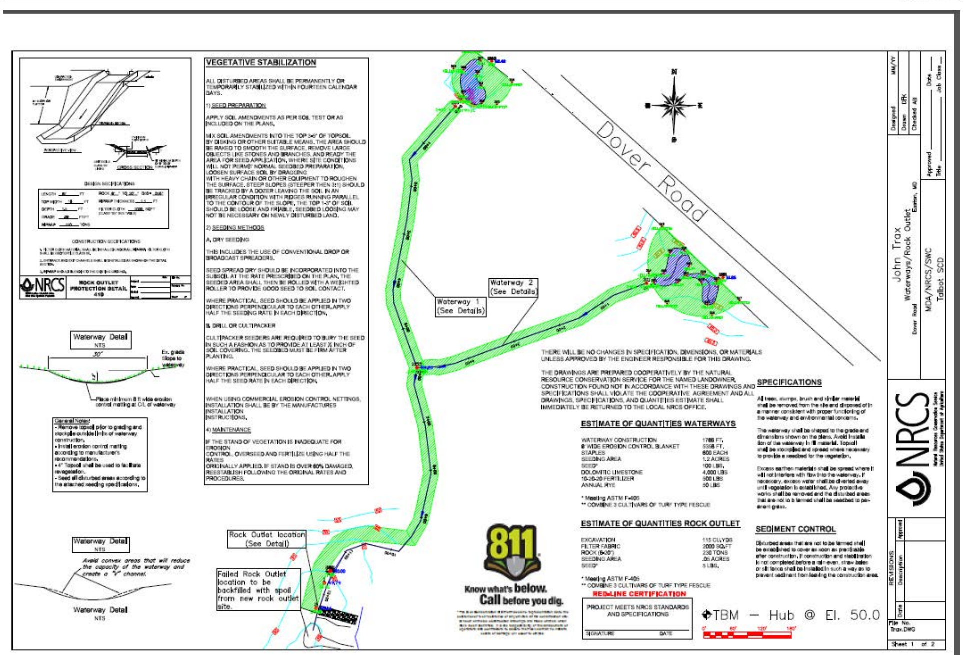
Constituent	Total Project Retention (lbs./year)	Project Cost	Cost/lb. removed
TN	322	$8,500	$26
TP	14.2		$598
TSS	2,268		$4

Dover Road Wetland and Waterway

Project Description: Wetland Restoration and Grass Waterway

This project demonstrated the use of small wetland cells/ detention basins in combination of a grass waterway to treat both cropland and road runoff. The private landowner was experiencing an erosion issue at the downstream end of a concentrated flowpath through his field that entered a headwater stream. He was interested in addressing the erosion issue in his field and supporting a targeted approach to addressing water quality concerns in the county. Small wetland cells totaling 0.3 acres were excavated just downstream of the road to capture flows coming off the road and through culverts under the road. Once the wetland cells fill, water then flows into a grass waterway to continue to filter nutrients and sediments before entering a headwater stream through a stabilized rock outlet. The project design was funded by CBF and construction under CREP and this grant.





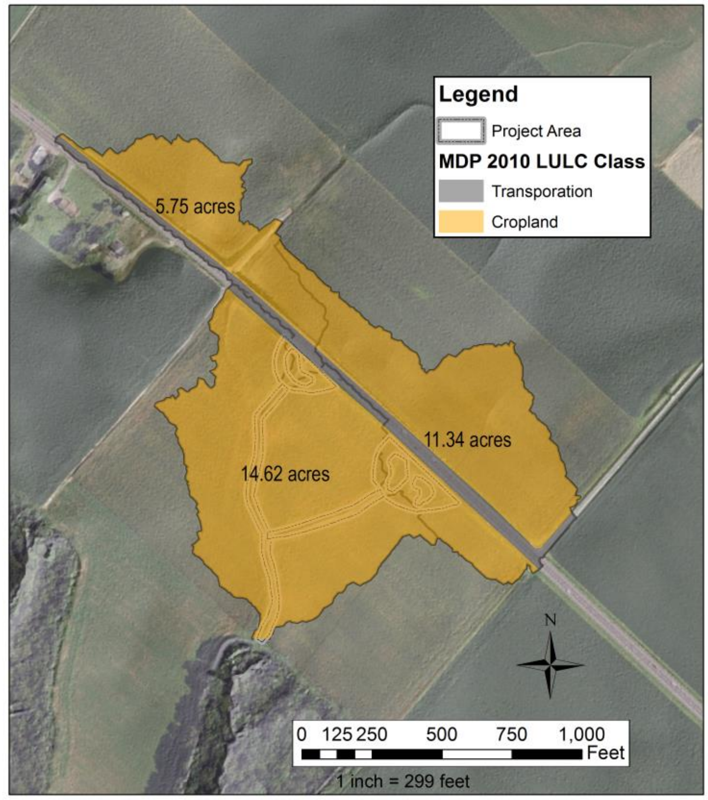
Dover Road Wetland/ Grass Waterway project designs.

Dover Road Site Pre-restoration. Note concentrated flow path starting at the bottom left corner of photograph and continuing to the woods where it enters a headwater stream.

Erosion issue at the edge of farmfield leading into a headwater stream on the Dover Road site. The project addressed both water quality and erosion concerns.

Construction of wetland cells/ detention basins at the upper end of grass waterway at the Dover Road Site.

Dover Road wetland cell post-construction after a storm event.



Contributing drainage area to Dover Road Wetland and Waterway site and associated landuse.

Table 4a. Loading Rates in Drainage Area for Dover Road Wetlands and Grass Waterway

MD Land Use	Acres	TN Loading rate Lb./ac/yr	TN Load lbs/year	TP Loading Rate Lb./ac/yr	TP Load lb/year	Sed Loading Rate Lb./ac/yr	Sed Load lb./year
Development*	2.2	7.31	16	0.43	0.9	143	316
Cropland**	29.5	18.19	536	0.71	21.0	185.4	4,365
TOTAL	31.7		552		21.9		4,681

*Urban NonReg - impervious developed
** Agriculture - nutrient management hightill without manure

Table 4b. Predicted retention of nitrogen, phosphorus and sediment for wetland at Dover Road based on loads from Table 4a.

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Wetland	Total Retention (lbs./year)
TN	25%	121	7	128
TP	50%	9.7	0	9.7
Sediment	15%	628	71	699

Table 4c. Predicted retention of nitrogen, phosphorus and sediment for grass waterway at Dover Road based on loads from Table 4a

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Perennial Grass	Total Retention (lbs./year)
TN	10%	52	17	69
TP	10%	2.0	0.2	2.2
Sediment	50%	2,163	168	2,331

Table 4d. Predicted retention of nitrogen, phosphorus and sediment for grass buffer at Dover Road based on loads from Table 4a

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Perennial Grass	Total Retention (lbs./year)
TN	39%	113	26	139
TP	39%	4.5	0.3	4.8
Sediment	52%	1,309	262	1,571

Table 4e. Total predicted retention of nitrogen, phosphorus and sediment for the project and cost efficiency at Dover Road

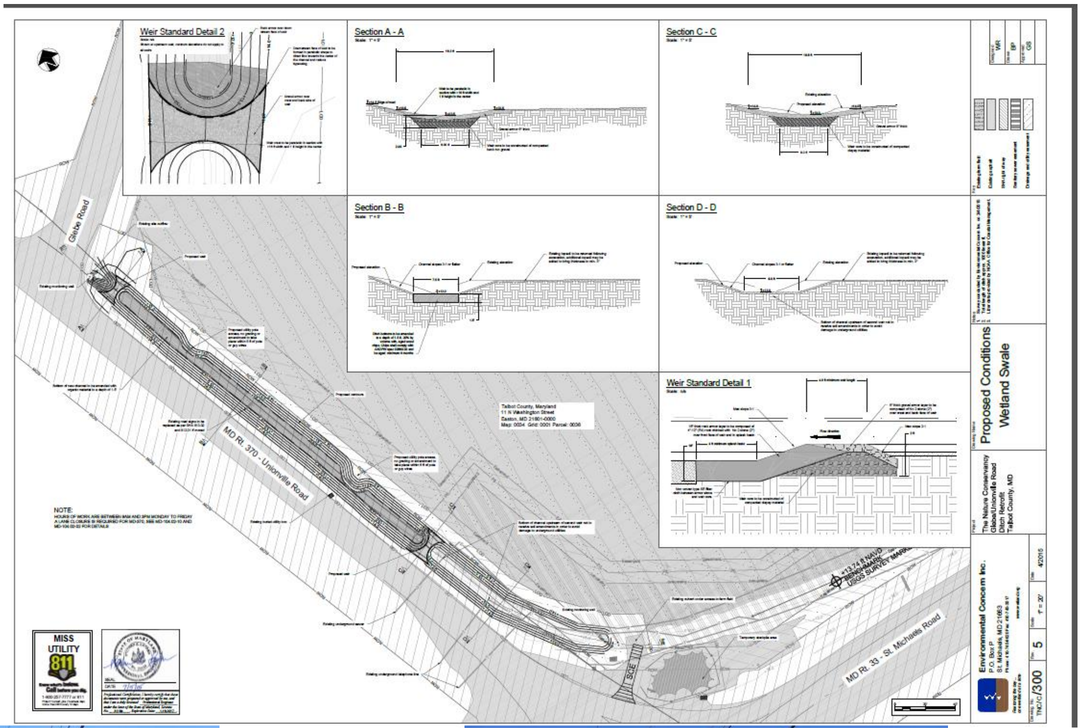
Constituent	Total Project Retention (lbs./year)	Project Cost	Cost/lb. removed
TN	336	$12,000	$36
TP	16.7		$719
TSS	4,601		$3

Unionville Road

Project Description: Wetland Swale

This project demonstrated a highly engineered swale design in a county roadside ditch. The site is located on county property and the county was interested in installing a variety of practices to demonstrate different approaches to improving water quality on the site. The existing ditch was widened and rock weirs were installed to slow the movement of water through the ditch. The soils in the bottom of the ditch were amended by adding woodchips to increase the organic matter/ carbon source to enhance denitrification and the site was planted with wetland plants. The swale/wetland will filter nutrients and sediment from the adjacent cropland and roads before continuing downstream to a local waterway. This project design and a portion of the construction was funded by this grant. The remaining construction costs were covered by funds that have been allocated by the county council to improve water quality with roadside ditch retrofits. This project is one of our monitoring locations.

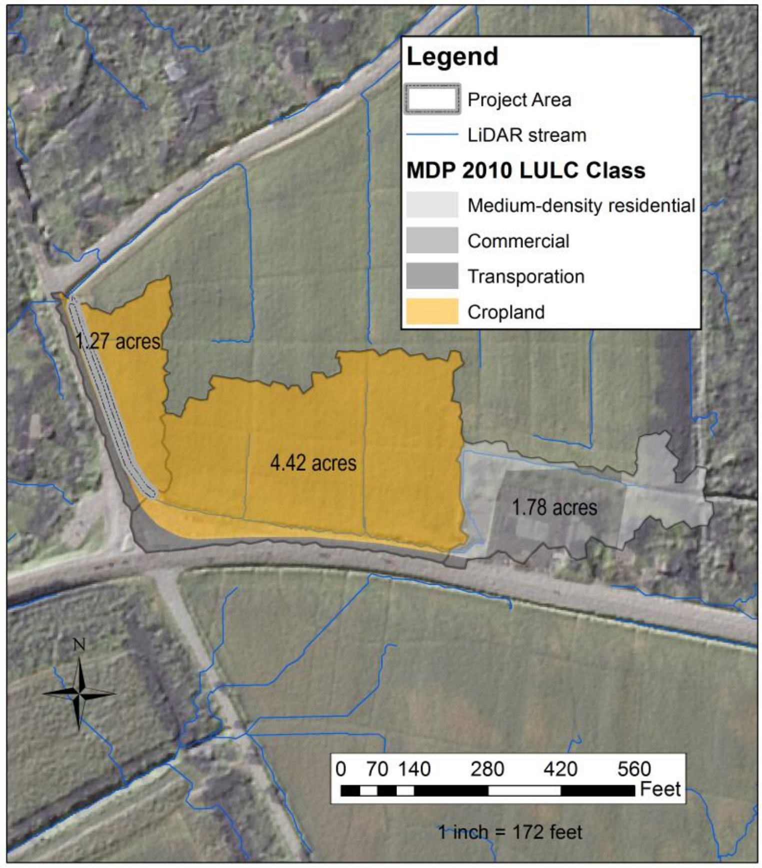
Unionville Wetland/Swale Design



Unionville Wetland/ Swale pre-restoration April 2016

Unionville Wetland/Swale during restoration adding woodchips to enhance nutrient retention April 2016.

Jnionville Road site post-restoration April 2016. The site vas hydro-seeded and planted with wetland plants. Alan Girard is standing on one of the rock weirs designed to low the flow of water and increase nutrient retention.



Contributing drainage area to Unionville Road site and associated landuse.

Table 5a. Loading Rates in Drainage Area for Unionville Road Bioswale

MD Land Use	Acres	TN Loading rate Lb./ac/yr	TN Load lbs/yea r	TP Loading Rate Lb./ac/yr	TP Load lb/year	Sed Loading Rate Lb./ac/yr	Sed Load lb./year
Development and Roads*	2.2	7.14 to 7.31	16	0.43	0.8	143	144
Cropland (21)**	5.3	18.19	96	0.71	3.8	185.4	782
TOTAL	7.5		112		4.6		926

*Urban NonReg - impervious developed

** Agriculture - nutrient management hightill without manure

Table 5b. Predicted retention of nitrogen, phosphorus and sediment for bioswale at Unionville Road based on loads from Table 5a

Constituent	**Practice Efficiency**	**BMP Retention (lbs/year)**	**Land Use Conversion Reduction (lbs/year) Cropland to Wetland**	**Total Retention (lbs./year)**
TN	37%	41	1.7	42.7
TP	10%	0.5	0	0.5
Sediment	50%	463	17	480

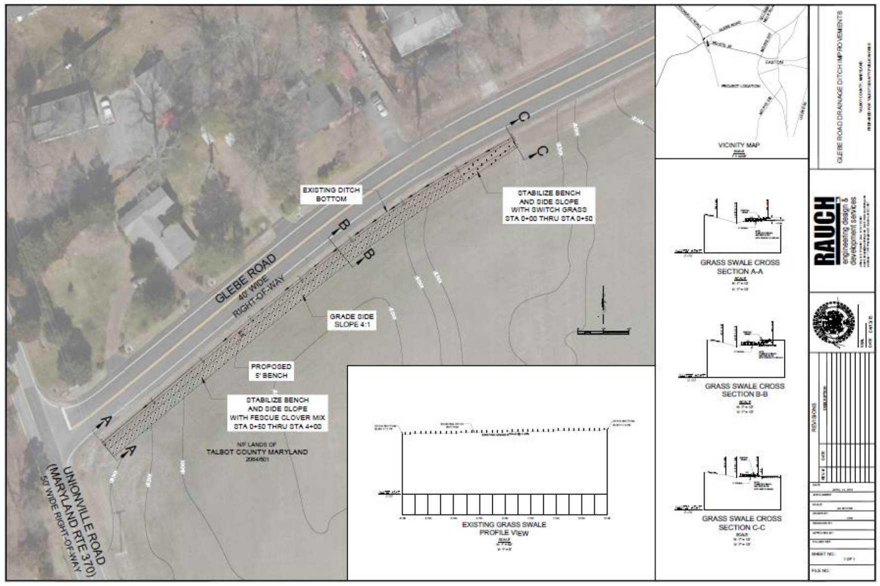
Table 5c. Total predicted retention of nitrogen, phosphorus and sediment for the project and cost efficiency at Unionville Road

Constituent	Total Project Retention (lbs./year)	Project Cost	Cost/lb. removed
TN	42.7	$51,990	$1,218
TP	0.5		$103,980
TSS	480		$108

Glebe Road

Project Description: 2-stage Roadside Ditch

This project demonstrated a 2-stage ditch retrofit along a high visibility road in the county on the same county-owned property as the Unionville Road site. Four hundred feet of a county roadside ditch was enhanced by excavating a 5ft. bench on the field side of the ditch and creating a 3:1 slope to the field. The wetland bench was approximately 6 inches higher than the mean high water of the ditch. The original topsoil was removed during excavation and then placed back on the bench and slope. The bench and slope were stabilized with curlex and seeded with white clover. Seven months post- restoration, the wetland bench has a thick cover of white clover. The wetland bench will filter water from the adjacent field and road during storm events and thus reduce nutrients and sediment being diverted downstream. The project design and construction was funded by the county with funds that were dedicated by the county council to improve water quality.

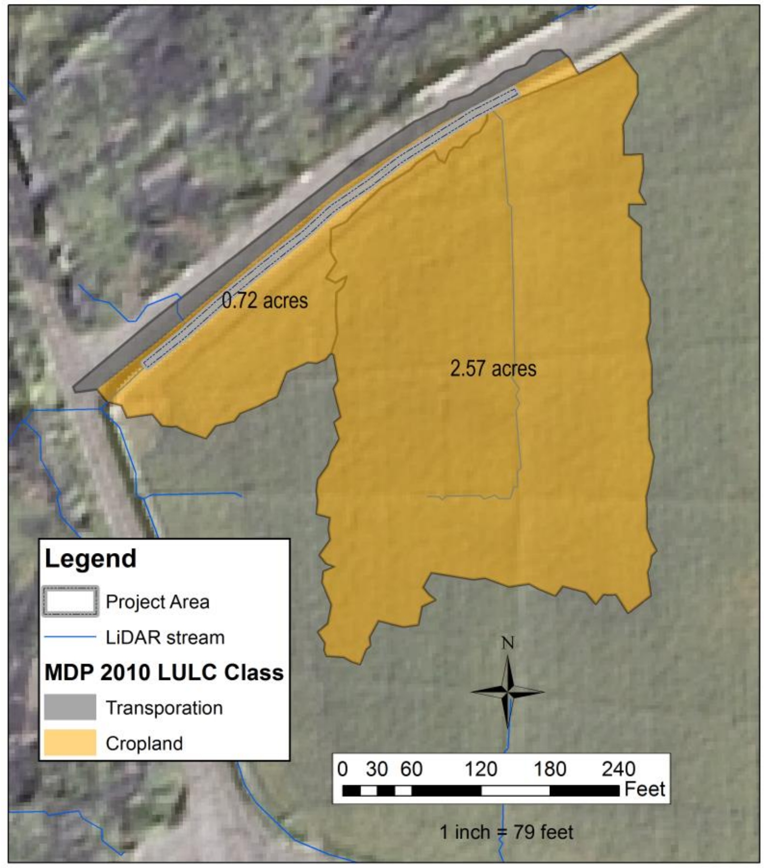


Glebe 2-stage Roadside Ditch Design

Glebe 2-stage roadside ditch pre-restoration, April 2015.

Glebe 2-stage roadside ditch during restoration, April 2015.

Glebe Road 2-stage ditch post-restoration June 2016.



Contributing drainage area to Glebe Road site and associated landuse.

Table 6a. Loading rates in drainage area for Glebe Road 2-stage ditch

MD Land Use	Acres	TN Loading rate Lb./ac/yr	TN Load lbs/year	TP Loading Rate Lb./ac/yr	TP Load lb/year	Sed Loading Rate Lb./ac/yr	Sed Load lb./year
Development*	0.2	7.31	1	0.43	0.1	143	23
Cropland**	3.1	18.19	57	0.71	2.2	185.4	465
TOTAL	3.3		58		2.3		488

*Urban NonReg - impervious developed

** Agriculture - nutrient management hightill without manure

Table 6b. Predicted retention of nitrogen, phosphorus and sediment for 2-stage ditch[a] at Glebe Road based on loads from Table 6a

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Wetland	Total Retention (lbs./year)
TN	25%	15	1	16
TP	50%	1.2	0	1.2
Sediment	15%	73	8.5	81.5

a – evaluated the "bench" in the 2-stage design as a 0.05ac. wetland

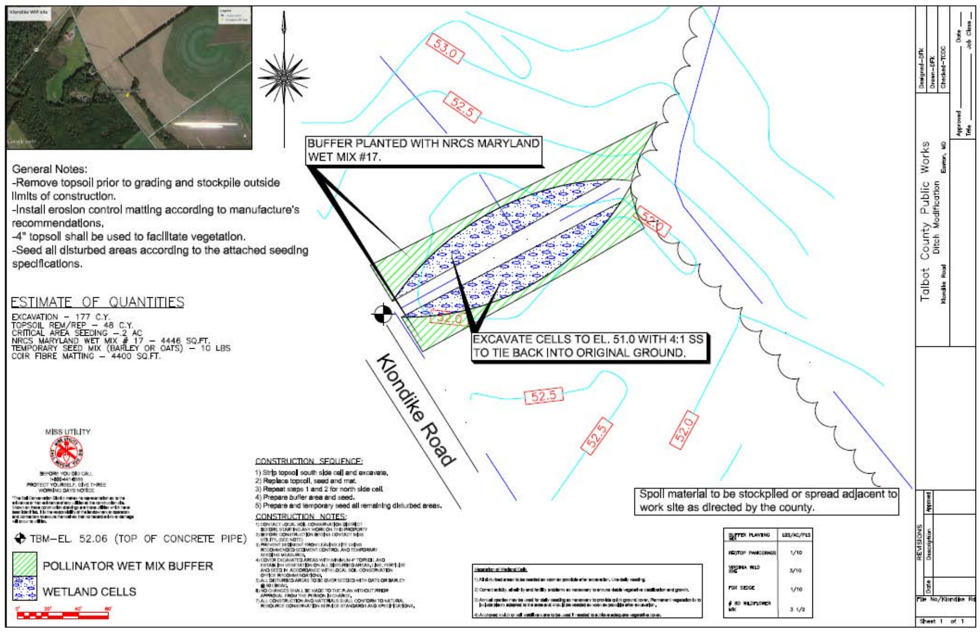
Table 6c. Total predicted retention of nitrogen, phosphorus and sediment for the project and cost efficiency at Glebe Road

Constituent	Total Project Retention (lbs./year)	Project Cost	Cost/lb. removed
TN	16	$9,900	$619
TP	1.2		$8,250
TSS	81.5		$121

Klondike Wetland

Project Description: Wetland Swale
This project demonstrated the creation of shallow wetlands adjacent to a ditch that conveys water from a county road and cropland into a headwater stream. The property is owned by Talbot County and the goal was to demonstrate practices that improve water quality and minimize the loss of cropland. The land adjacent to the field ditch was a low spot and required minimal excavation to restore the wetlands and allow water from the ditch to flow into these areas during small storm events. The wetland was stabilized with jute matting which provided adequate stablilization and is preferred over curlex as it is made from all natural fibers rather than plastic. A buffer was planted with a pollinator mix adjacent to the wetland to square off the site making it easier to farm around. The wetland will filter nutrients and sediment from the cropland and road before entering the local waterway. The project design and construction was funded under this grant. This site is one of our monitoring locations.

Klondike Wetland Design



Klondike Wetland pre-restoration November 2015, monitoring well in the center of the ditch.

Klondike Wetland post-restoration with jute matt used for sediment and erosion control November 2016.

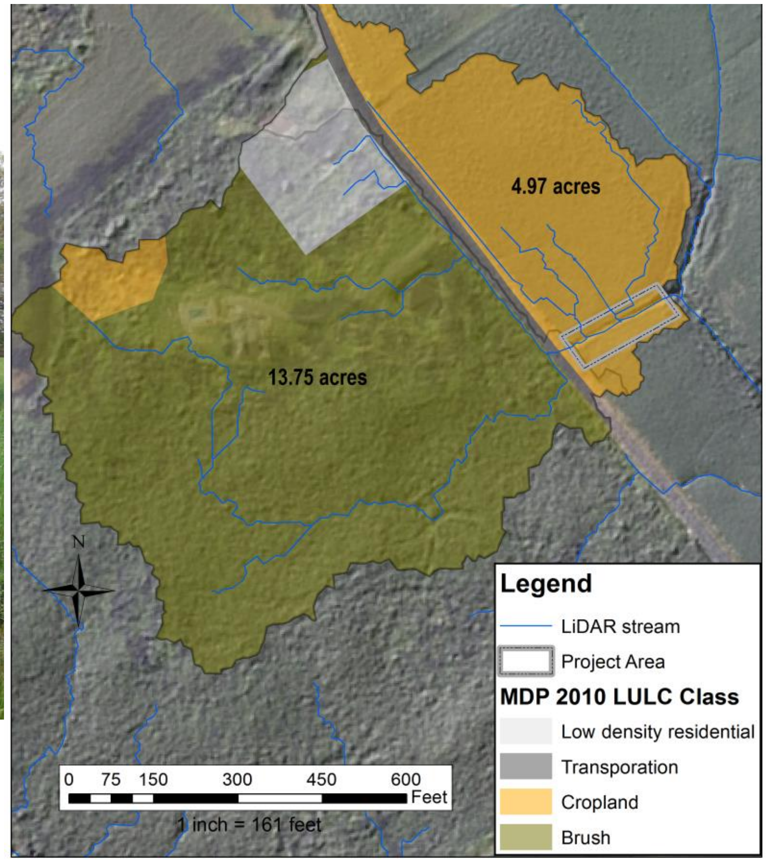


Table 7a. Land Use/ Loading Rates in drainage area for Klondike Wetland site

MD Land Use	Acres	TN Loading rate Lb./ac/yr	TN Load lbs/year	TP Loading Rate Lb./ac/yr	TP Load lb/year	Sed Loading Rate Lb./ac/yr	Sed Load lb./year
Development and Roads*	1.7	7.14 to 7.31	12	0.43	0.6	143	124
Cropland**	5.0	18.19	90	0.71	3.5	185.4	735
Brush/ Forest	12.1	1.41	17	0.05	0.6	16.1	194
TOTAL	18.8		119		4.7		1,053

*Urban NonReg - impervious developed

** Agriculture - nutrient management hightill without manure

Table 7b. Predicted retention of nitrogen, phosphorus and sediment for wetland at Klondike based on loads from Table 7a.

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Wetland	Total Retention (lbs./year)
TN	25%	30	5	35
TP	50%	2.3	0.1	2.4
Sediment	15%	158	51	209

Table 7c. Predicted retention of nitrogen, phosphorus and sediment for grass buffer at Klondike based on loads from Table 7a

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Perennial Grass	Total Retention (lbs./year)
TN	39%	46	1	47
TP	39%	1.8	0	1.8
Sediment	52%	548	16	564

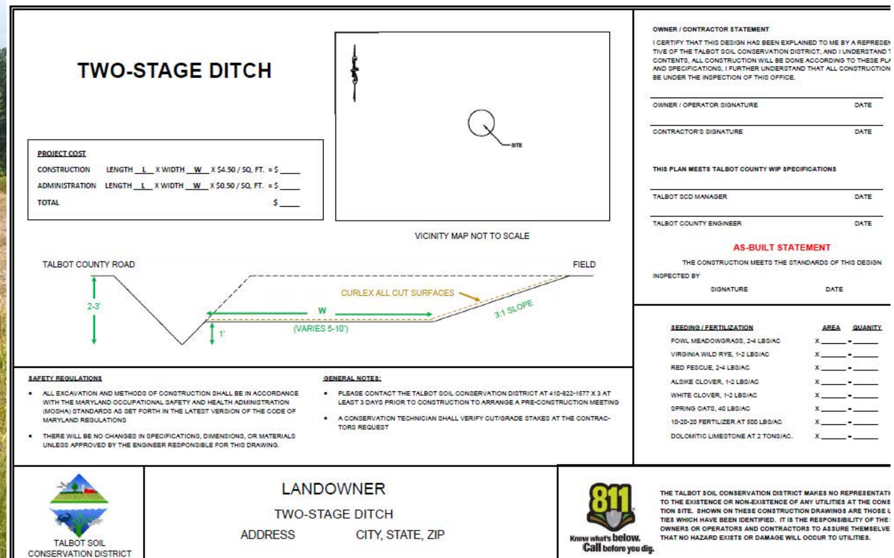
Table 7d. Total predicted retention of nitrogen, phosphorus and sediment for the project and cost efficiency at Klondike

Constituent	Total Project Retention (lbs./year)	Project Cost	Cost/lb. removed
TN	82	$7,323	$89
TP	4.2		$1,743
TSS	773		$9

Bellevue Field Ditch

Project Description: 2-stage ditch
This project showcased a 2-stage ditch retrofit on a field ditch on private property owned by an influential farmer in county. Benches were excavated on both sides of the ditch to a width of 3-4 feet and then sloped to the field a 4:1 angle. The wetland bench was designed to be approximately 6 inches higher than the mean high water of the ditch and amended with topsoil and seeded with oats. Hydro-mulching was applied for stabilization which provides a good alternative to using matting that may contain plastic. A 15ft. cool season grass buffer was planted on both sides. The wetland bench will filter water from the adjacent field and road during storm events and thus reduce nutrients and sediment being diverted downstream. The project utilized a standardized design developed by the Talbot Conservation Districts in response to this grant project and construction was funded by this grant.

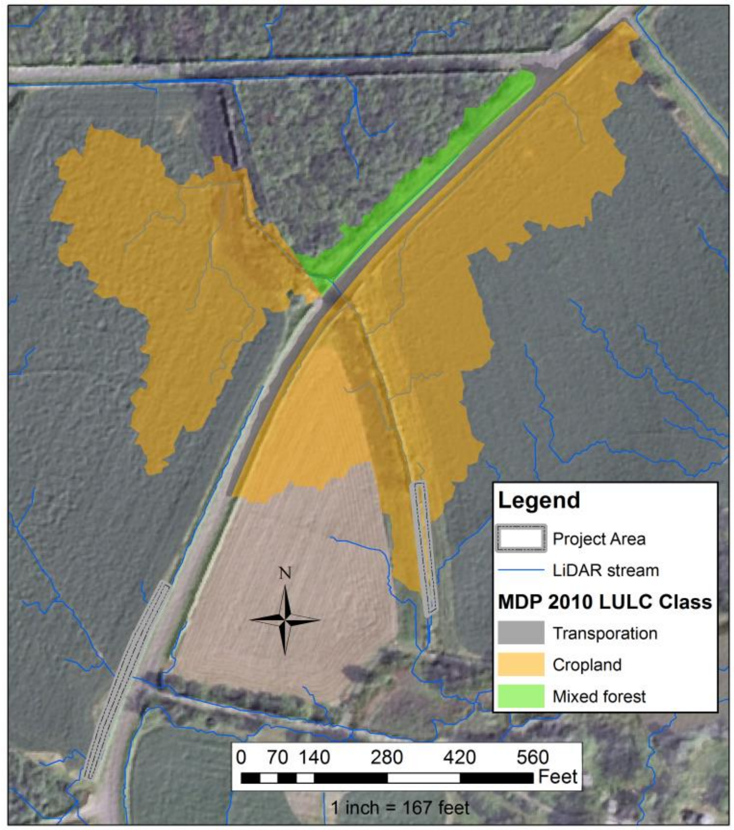
Bellevue Field Ditch pre-restoration June



Talbot County Soil Conservation District standard design for 2-stage ditch applied to the Bellevue Field Ditch.

Bellevue Field Ditch during construction, enhancing a trapezoidal ditch into a 2-stage ditch.

Bellevue Field Ditch during construction, creating wetland benches on both sides of ditch to improve water quality, June 2016.



Contributing drainage area to Swaine field 2-stage ditch site and associated landuse.

Bellevue Field Ditch during construction, after top soil and seeding, the area was hyro-mulched as an alternative stabilization technique that avoid the use of matting that may contain plastic, June 2016.

Table 8a. Land use and associated loading rates in drainage area for Bellevue Field 2-stage ditch

MD Land Use	Acres	TN Loading rate Lb./ac/yr	TN Load lbs/year	TP Loading Rate Lb./ac/yr	TP Load lb/year	Sed Loading Rate Lb./ac/yr	Sed Load lb./year
Roads*	.6	7.31	4.0	0.43	0.2	143	79
Cropland**	9.8	18.19	178	0.71	7.0	185.4	1,451
Forest	0.6	1.41	1	0.05	0.0	16.1	10
TOTAL	11.0		183		7.2		1,540

*Urban NonReg - impervious developed

** Agriculture - nutrient management hightill without manure

Table 8b. Predicted retention of nitrogen, phosphorus and sediment for 2-stage ditch[a] at Bellevue Field based on loads from Table 8a.

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Wetland	Total Retention (lbs./year)
TN	25%	46	.3	46
TP	50%	3.6	0	3.6
Sediment	15%	231	3	234

a – evaluated the "bench" in the 2-stage design as a 0.02ac. wetland

Table 8c. Predicted retention of nitrogen, phosphorus and sediment for grass buffer at Bellevue Field based on loads from Table 8a

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Perennial Grass	Total Retention (lbs./year)
TN	39%	71	1	72
TP	39%	2.8	0	2.8
Sediment	52%	801	15	816

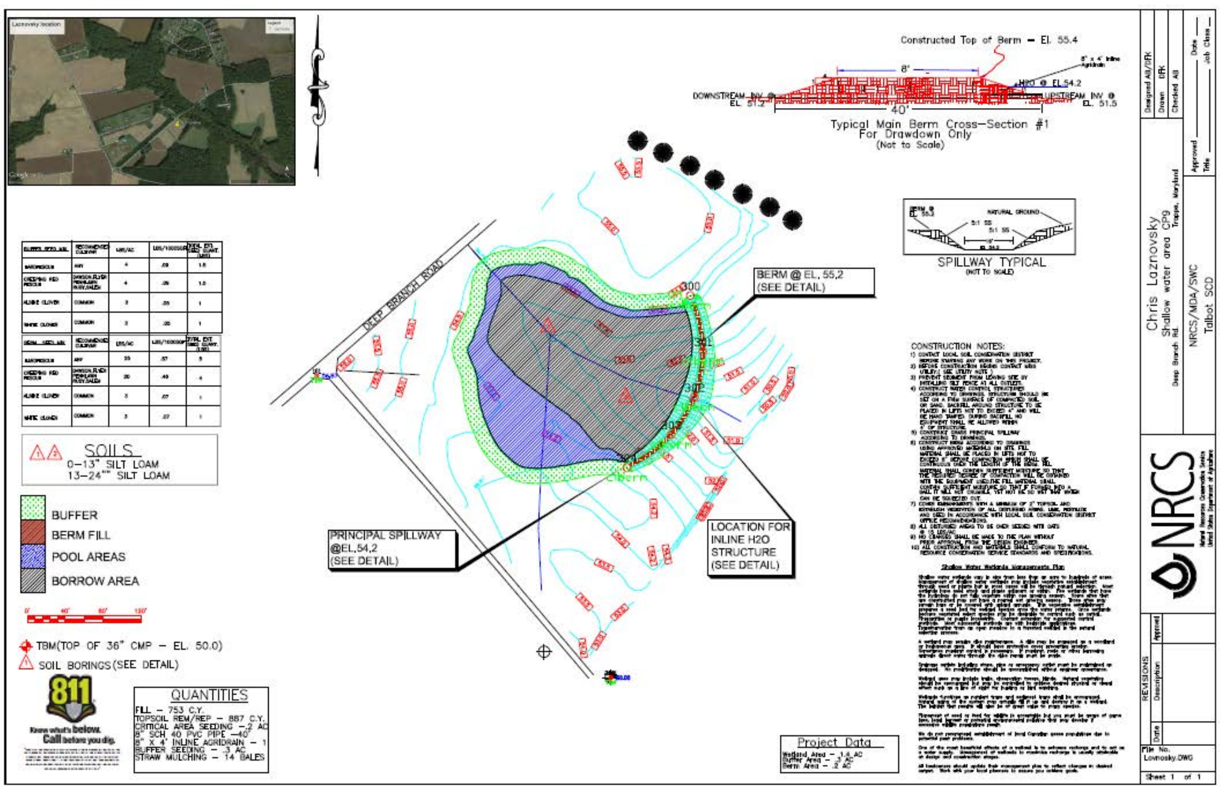
Table 8d. Total predicted retention of nitrogen, phosphorus and sediment for the project and cost efficiency at Bellevue Field

Constituent	Total Project Retention (lbs./year)	Project Cost	Cost/lb. removed
TN	118	$7,980	$68
TP	6.4		$1,247
TSS	1,050		$8

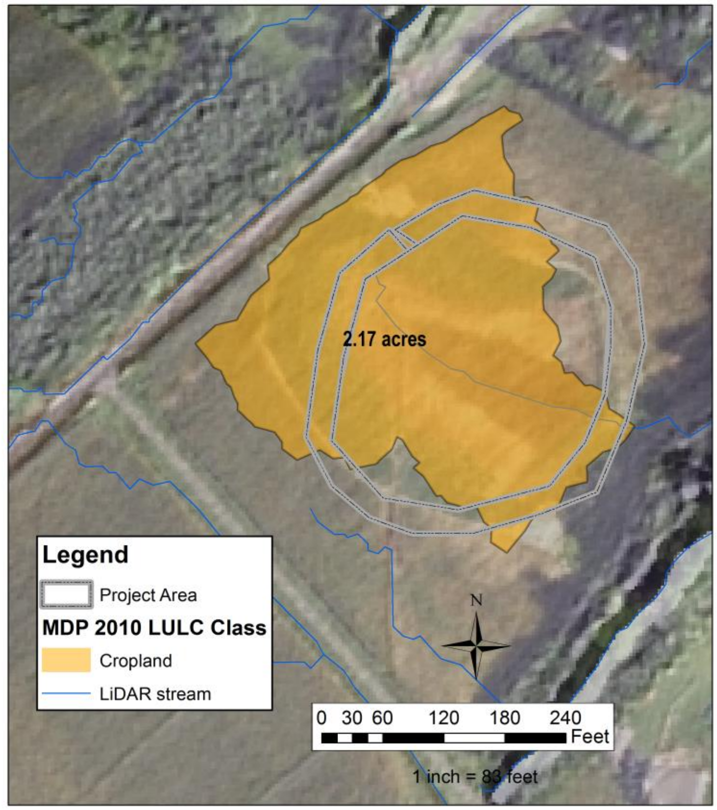
Deep Branch Wetland

Project Description: Wetland Swale
This project demonstrated the restoration of a shallow water wetland in cropland where it would create wildlife habitat. A shallow field lead diverted water from a county road cropland to the wet area and then into a headwater stream. A shallow wetland was restored by excavating a depression, constructing a berm, and installing a water control structure to hold water and create a 1.4 acre wetland with an adjacent 35ft cool season grass buffer. The wetland was seeded with oats for stabilization and will naturally colonize with native vegetation. The wetland will filter nutrients and sediment from the cropland before entering the local waterway. This project was funded under the Conservation Reserve Enhancement Program (CREP).

Deep Branch Wetland Design



Deep Branch wetland post-restoration June 2006.



Contributing drainage area to Deep Branch Wetland and Waterway site and associated landuse.

Table 9a. Land use and associated loading rates in drainage area for Deep Branch Wetland

MD Land Use	Acres	TN Loading rate Lb./ac/yr	TN Load lbs/year	TP Loading Rate Lb./ac/yr	TP Load lb/year	Sed Loading Rate Lb./ac/yr	Sed Load lb./year
Roads*	0	7.31	0	0.43	0	143	0
Cropland**	2.2	18.19	40	0.71	1.6	185.4	321
TOTAL	2		40		1.6		321

*LiDAR did not capture road in the drainage area, field conditions indicate that drainage from the road flows to the wetland.
** Agriculture - nutrient management hightill without manure

Table 8b. Predicted retention of nitrogen, phosphorus and sediment for 2-stage ditch[a] at Bellevue Field based on loads from Table 8a.

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Wetland	Total Retention (lbs./year)
TN	25%	10	24	34
TP	50%	0.8	0.3	1.1
Sediment	15%	48	239	287

a – evaluated the “bench” in the 2-stage design as a 0.02ac. wetland

Table 8c. Predicted retention of nitrogen, phosphorus and sediment for grass buffer at Bellevue Field based on loads from Table 8a

Constituent	Practice Efficiency	BMP Retention (lbs/year)	Land Use Conversion Reduction (lbs/year) Cropland to Perennial Grass	Total Retention (lbs./year)
TN	39%	15	10	25
TP	39%	0.6	0.1	0.7
Sediment	52%	167	103	270

Table 8d. Total predicted retention of nitrogen, phosphorus and sediment for the project and cost efficiency at Bellevue Field

Constituent	Total Project Retention (lbs./year)	Project Cost	Cost/lb. removed
TN	59	$8,500	$144
TP	1.8		$4,722
TSS	557		$15

Preliminary Monitoring Results

Overview: To investigate impacts of roadside ditches to downstream water quality, we initiated monitoring programs at three sites, including the bioswale site along Unionville Road, the restored wetland draining Klondike Road, and a third “control” site along Klondike Road at which no bmp’s were implemented. The monitoring objectives included: 1) establishing a network of observation wells to monitor channel flow dynamics and groundwater contributions; 2) comparing nutrient and sediment concentrations observed during storm events to evaluate human impacts; and 3) evaluating the relative importance of runoff from croplands and impervious surfaces, as well as groundwater, based on an endpoint mixing model analysis of comprehensive water quality analyses. We expected that observed water quality would reflect predominant land cover and land management practices in the local contributing area as predicted from the Chesapeake Bay Program-based assessment; and that differences between the inflow and outflow locations over time would reflect the effects of the ditch mitigation/management strategy.

Hydrogeologic Setting: The geologic setting of the Delmarva Peninsula strongly influences near-surface ground- and surface water interactions. A horizontal sequence of unconsolidated marine and estuarine sediments deposited throughout the Cenozoic Era (i.e., from 66 million years ago to present day) has influenced soil development and topography across the region (Owens and Denny, 1979). In the low lying areas of Talbot County, where our study sites are located, surficial deposits consist of young (less than 100 thousand years) estuarine sediments deposited when the Chesapeake Bay was 10 to 15 feet above current elevation and the area formed the old Chesapeake Bay bottom (Owens and Denny, 1979). This geologic unit includes irregular beds of mixed sand, silt, and clay referred to as the Kent Island formation. Surface topography reflects a combination of coastal sedimentary processes and also fluvial river down-cutting, the latter occurred mainly during ice sheet maximums when sea levels declined to more than 150 ft below its current position (Colman *et al.*, 1990).

Climate: Talbot County has a humid subtropical climate characterized by hot humid summers and mild winters (Reybold, 1970). Annual temperatures typically vary between 28°F and 88°F and average 56°F. Proximity to the Chesapeake Bay and the Atlantic Ocean reduce extreme weather fluctuations. Precipitation also is evenly distributed, although summer rainfall often occurs with intense thunderstorms of short duration. Historically reported annual rainfall, collected between 1940 and 2009, ranges between 20 and 60 inches per year and averages 45 inches per year (UMD 2009). Temperature and precipitation measures for 2015 and 2016 are presented in relation to long-term averages in Figure 5.

Field Instrumentation: To evaluate surface- and ground-water interactions at each of the three study sites, we installed watertable wells at the ditch inlet and outlet, and a piezometer nest at the center of each ditch. The wells were installed by a licensed consulting firm, Hillis-Carnes. Boring logs collected during installation are presented in Appendix B and include details about well construction. Following installation, all wells were surveyed to a common benchmark and geo-referenced to within one meter accuracy using a handheld GPS unit.

Manual water level measures were collected intermittently since installation during April 2015. In addition, all monitoring wells were instrumented with continuous, hourly water level and temperature readings to characterize the timing, frequency, and magnitude of flooding within the ditch systems. Continuous electrical conductivity (EC) loggers also were deployed to record changes in water quality at an hourly interval. The Onset pressure transducer loggers (model HOBO U20L-04) and EC meters (model HOBO U24-001) will remain deployed to develop long-term hydoperiod characterizations.

Hourly weather data including temperature, precipitation, and barometric pressure, which were used to convert the logger pressure data to water level depths, were obtained from the Easton/Newnam Field Regional Airport station. To help validate the data, the continuous water level data also were compared with stream discharge measured at the USGS Tuckahoe Creek gauge station (USGS 01491500) for correspondence in the timing and magnitude of peak flow events. Although there is no hydrologic connection between the USGS gauge location and the monitoring sites, we expected correspondence in the timing and magnitude of peak flows, which would provide confidence in the conversion of the Onset pressure transducer data to absolute watertable elevations.

Water Quality Sampling: A first round of water quality samples was collected on December 3 by our contractor, Hillis-Carnes Consulting. Sampling was conducted within 24 hours of a 0.03 inch rain event as measured at the Easton/Newman Regional Airport. After purging the wells, samples were collected into field-rinsed, one liter sample bottles, using a peristaltic pump, and then stored on ice prior to delivery within 24 hours at Envirocorp Labs (Harrington, DE) or ALS Environmental in Middletown, PA. In the laboratory, samples were filtered through 0.45 micron paper. Targeted dissolved analytes included nitrate-N, ammonia-N, Total N, Ortho-phosphorus P, Total P, and Total Suspended Solids. Field measures included temperature, specific conductivity, and pH. Talbot County plans to support additional storm water quality sampling efforts, including full elemental analyses; however, logistical constraints did not allow for this work to be completed within the timeframe of this Trust Fund grant.

Preliminary Results for Unionville Road Bioswale, constructed April 2016: The Unionville Road bioswale site is located on the lower, outer Coastal Plain of Talbot County, which is characterized by extremely flat, low lying topography. Site elevations range between 4 and 5 m above mean sea level (Figure 6). The site is 0.75 km (0.5 miles) from the shoreline of Glebe Creek. Manual water level measures indicated a sloping watertable gradient from the upstream ditch to the outlet, with a consistent hydraulic gradient of approximately 0.002 m per m. Since the April 2015 well installations, recorded watertable elevations fluctuated between 1.13 m at the center of the ditch (GL2) to 1.52 m at the down-steam location (GL3). Maximum water depths ranged from 0.22 at the midpoint location (GL2) to 0.65 m, at the upstream location (GL1). Logger responses were similar across all locations: watertable elevations generally and the ditches flooded in response to precipitation events greater than 1 cm (approximately 0.5 inches), as observed at the Easton/Newnam Field Regional Airport (Figure 7). Flooding also corresponded with storm flow observed at the Tuckahoe Creek gauge station but not with Choptank tidal data. Converted pressure transducer data collected from the Unionville site wells during 2016 were consistent among all monitoring locations; however, results did not follow the patterns of watertable fluctuation observed since the 2015 installation. The logger data recorded after the December sampling event by Hillis and Carnes indicated more limited watertable fluctuations that were difficult to associate with weather patterns or with site management.

Nitrogen concentrations sampled from the Unionville bioswale site occurred within natural background ranges of Delmarva waters (Cushing *et al.*, 1973). Nitrate-N concentrations ranged between 0.2 and 0.4 mg liter (1 to 2 mg nitrate per liter), with a slightly higher concentration observed in the deep piezometer. Ammonia and nitrite concentrations were near the detection limits. In contrast, phosphate concentrations were elevated, exceeding 1 mg/L in the watertable wells located down-gradient of the inlet. The significant increase along the ditch site suggested either biogeochemical release within the ditch system or additional inputs from the adjacent field. Given the relatively small contributing area, the flat gradient, and the significant increases in concentration, the former is considered a more likely explanation.

Field measures and continuous logger recordings of electrical conductivity, ranging up to nearly 25,000 uS/cm, indicated a strong influence from either the Chesapeake Bay or human pollution (Figure 6). The highest measurement occurred at the outlet and was associated with a major rain event in late February 2016. Field conductivity measures in the late spring and early summer also indicated contamination: EC measures were highest in the shallow wells, ranging between 1,000 and 2,000 uS/cm and less than 500 uS/cm in the piezometer, 3.5 m below the land surface. Natural background EC of freshwaters across the Delmarva generally range between 50 and 200 uS/cm (Cushing *et al.*, 1973); whereas saltwater generally exceeds 50,000 uS/cm, and intermediate EC ranges often area associated with industrial waters (Deutsch, 1997), including contaminated road runoff (Backstrom *et al.*, 2003) and septic systems (Alhajjar *et al.*, 1990).

Table 9. Results of December 2, 2015 water quality sampling event at Glebe (GL) and Klondike Road (KLN/KLS).

Sampling Location	Ammonia NH3_mgL	Nitrate NO3_N_mgL	Nitrite NO2_N_mgL	Total Nitrogen TN_mgL	Ortho-Phosphate PO4_mgL	Total Phosphorus TP_mgL
GL1	*0.025*	0.21	*0.025*	2.84	*0.14*	0.27
GL2-PZ	0.32	0.40	*0.025*	2.54	*0.025*	1.31
GL2-WT	0.42	0.19	*0.025*	1.38	*0.025*	*0.05*
GL2	*0.025*	0.21	*0.025*	3.56	1.02	1.74
GL3	*0.025*	0.20	*0.025*	3.36	1.21	1.88
KLN1	0.05	0.67	*0.025*	3.93	0.09	0.68
KL2-PZ	*0.025*	0.21	0.025	1.24	*0.025*	*0.01*
KL2-WT	*0.025*	0.33	*0.025*	1.14	*0.025*	*0.05*
KLN2	*0.025*	0.57	*0.025*	5.20	*0.025*	1.50
KLN3	*0.025*	0.21	*0.025*	3.33	0.22	0.75
KLS1	*0.025*	0.22	*0.025*	4.04	*0.025*	0.74
KLS2-PZ	0.16	0.19	*0.025*	1.19	*0.025*	0.85
KL2-WT	0.23	0.21	*0.025*	1.09	*0.025*	0.36
KLS3	*0.025*	0.22	*0.025*	4.36	0.07	1.01

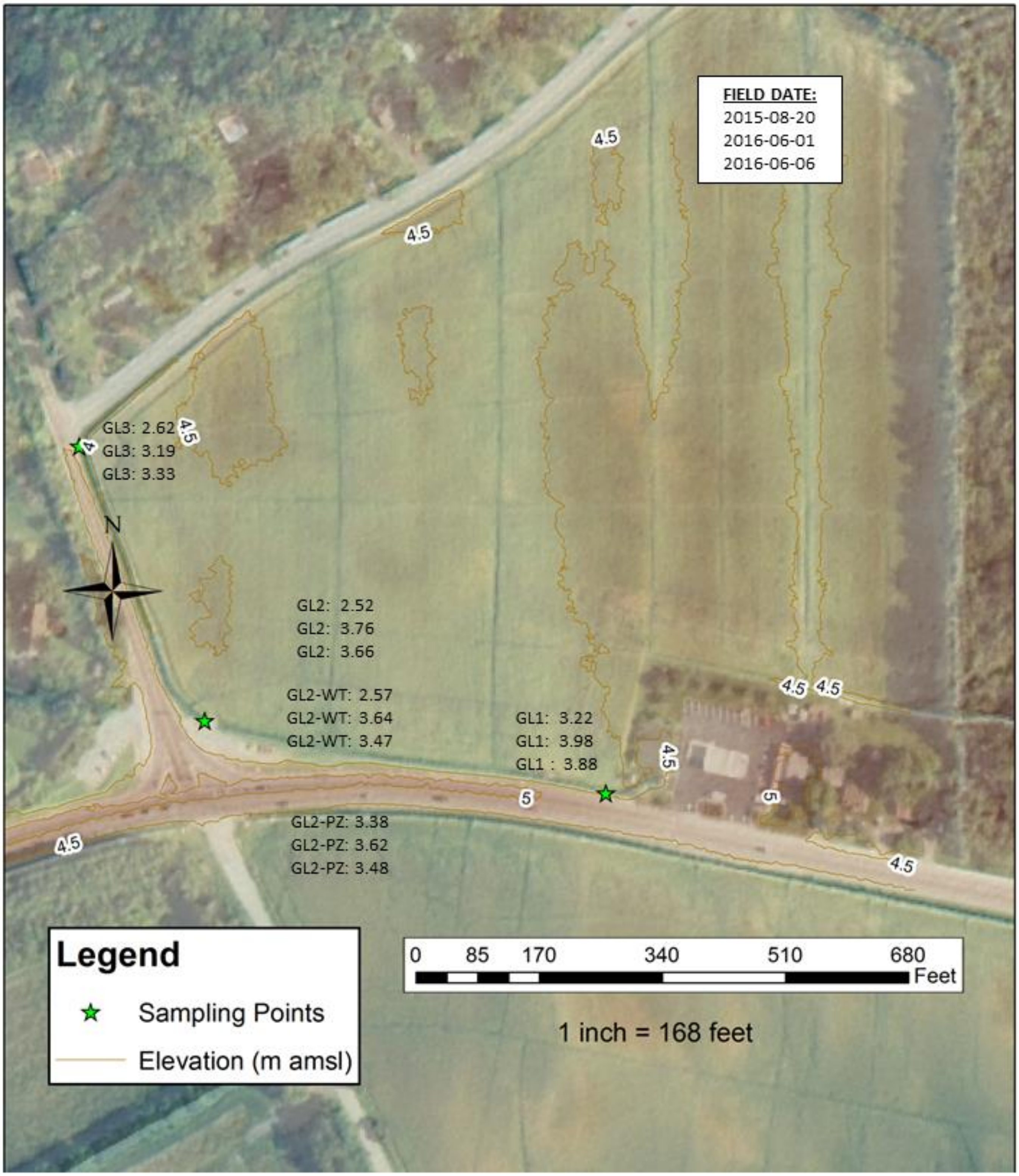


Figure 5. Water level measures (m above mean sea level) at the Unionville Road bioswale field monitoring. Results combined with the continuous logger data showed a consistent flow from the inlet at GL1 to the outlet at GL3. Lower watertable elevations in the piezometer (GL2-PZ), compared to the watertable well (GL2), indicated downward vertical flow. A second watertable well (GL2-WT) was installed to address concern of an intervening confining unit.

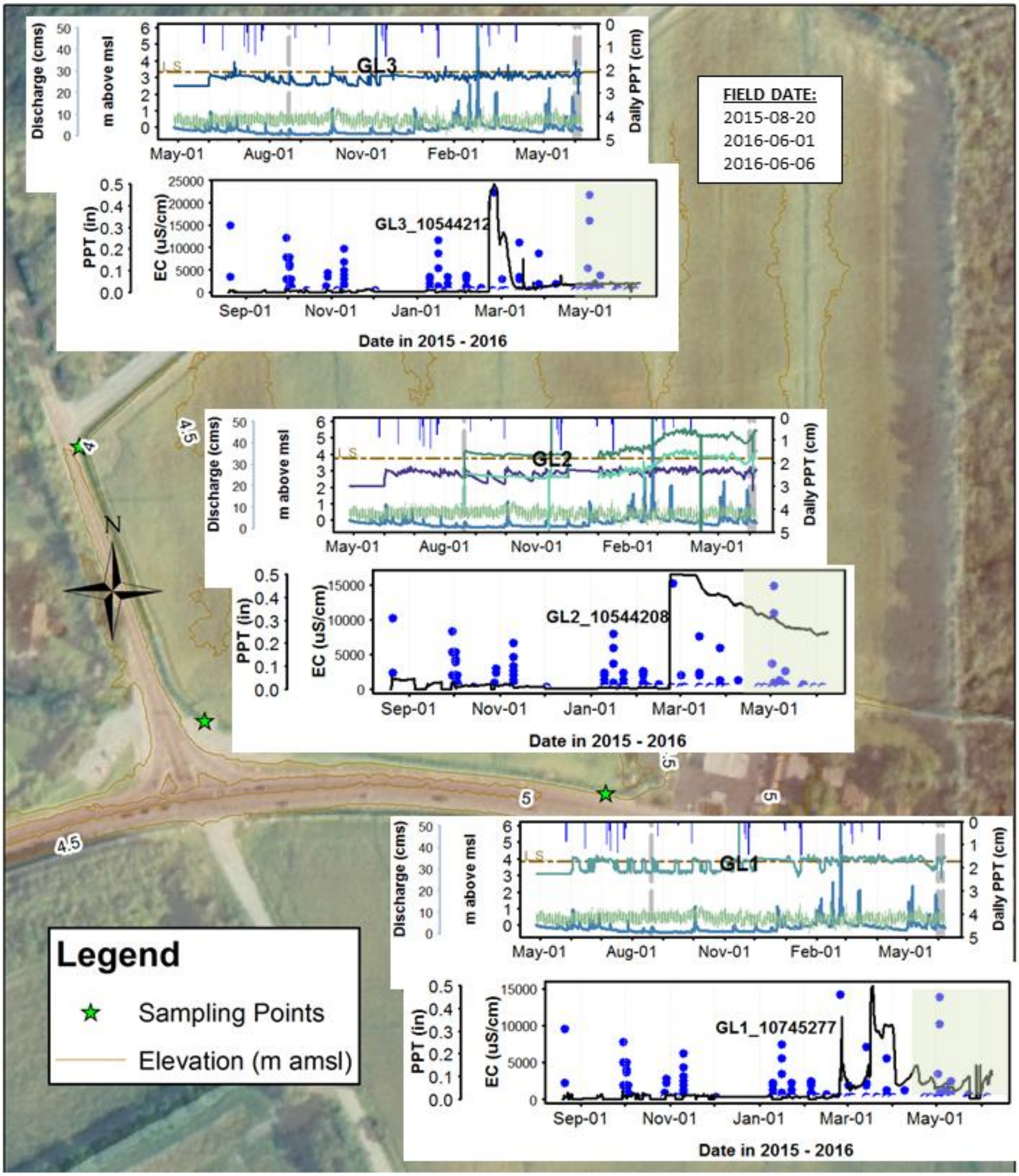


Figure 6. Continuous water level and electrical conductivity measures collected at the Unionville Roadside bioswale inlet (GL1 at the southeast corner of the site), midpoint (GL2 at the southwest corner), and outlet (GL2 at the northwest corner). For each of the three locations, the top panel compares measured water level data (aqua line overlapping the land surface (LS)) with tides (in green) and Tuckahoe Creek discharge (in blue). The bar graph indicates daily precipitation measured at the Easton/Newman Field Regional Airport. The bottom panels show electrical conductivity, which increased significantly during rain events, especially in late winter and early spring months.

Preliminary Results for the Klondike Road wetland, constructed November 2015: The Klondike site is situated within the Kings Creek sub-watershed of the Choptank River. Land elevations range between 15 and 17 m above mean sea level (Figure 7). Manual water level measures indicated a sloping watertable gradient from the upstream ditch to the outlet, with a consistent hydraulic gradient of approximately 0.002 m per m. Since the April 2015 well installations, recorded watertable elevations fluctuated over 1.5 m. The watertable was as deep as 1.5 m below the land surface at KLN1. Under flooded conditions, maximal water depths near the down-gradient creek approached 1.2 m. Logger responses were similar to those at Unionville Road bioswale site: watertable elevations generally and the ditches flooded in response to precipitation events greater than 1 cm (approximately 0.5 inches), as observed at the Easton/Newnam Field Regional Airport (Figure 8). Flooding also corresponded with storm flow observed at the Tuckahoe Creek gauge station but not with Choptank tidal data. Also similar to the Unionville site, converted pressure transducer data collected during 2016 did not follow the patterns of watertable fluctuation observed earlier. The logger data recorded after the December sampling event by Hillis and Carnes indicated more limited watertable fluctuations that were difficult to associate with weather patterns or with site management.

Nitrogen concentrations sampled from the Klondike wetland site occurred within natural background ranges of Delmarva waters (Cushing *et al.*, 1973), though these were slightly higher than observed at Unionville (0.2 to 0.7 mg nitrate-N per liter; 1 to 3 mg nitrate per liter). Ammonia and nitrite concentrations, and also ortho-phosphate concentrations were near the analytical detection limits.

Field measures combined with continuous logger recordings of electrical conductivity ranged up to 300 uS/cm and suggested only limited influence of human pollution (Figure 8). Again, EC measures appeared to spike during rain events, suggesting the occurrence of hydrologic flushing, perhaps from influx of runoff from roadways or agricultural fields.

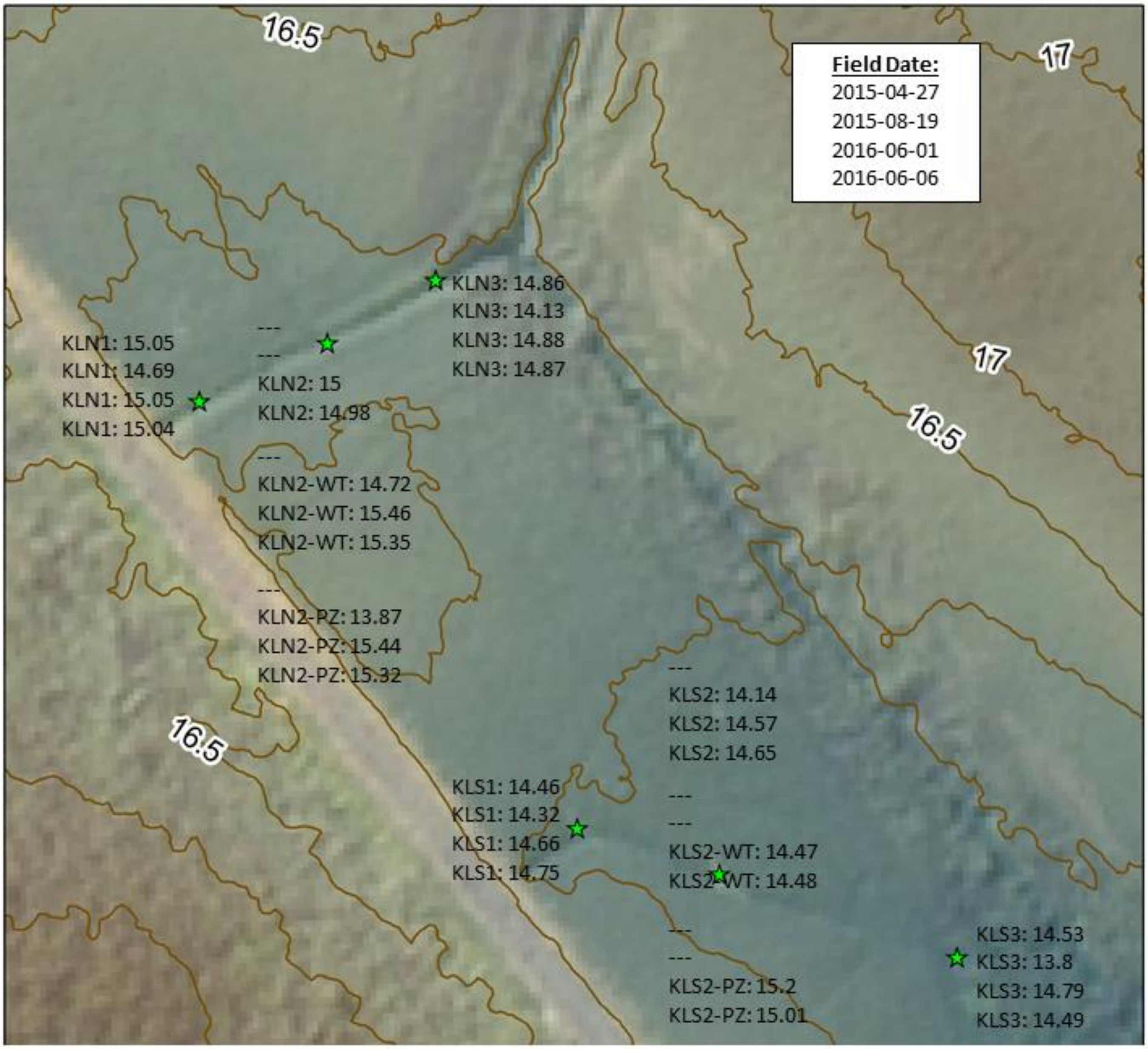
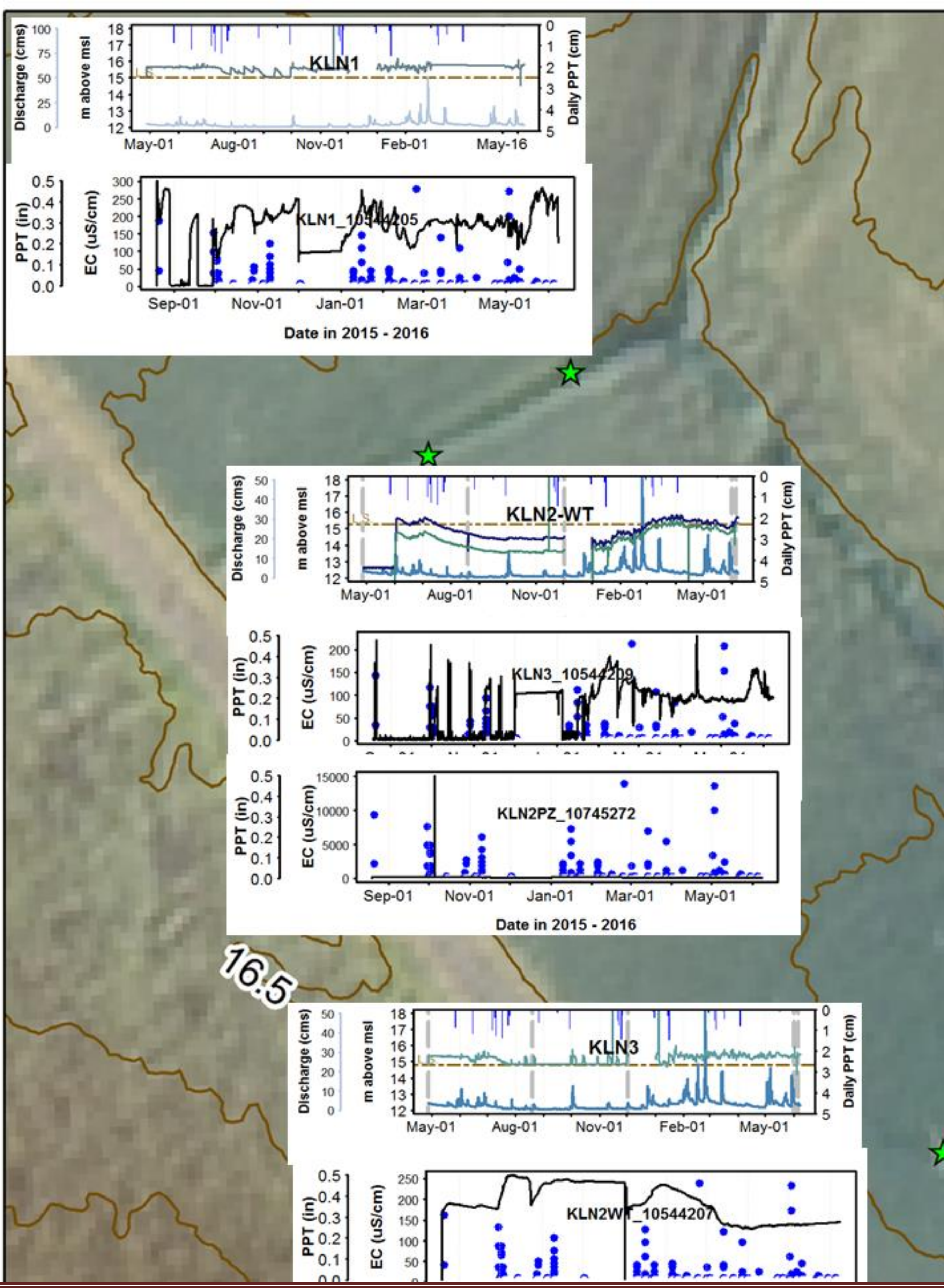
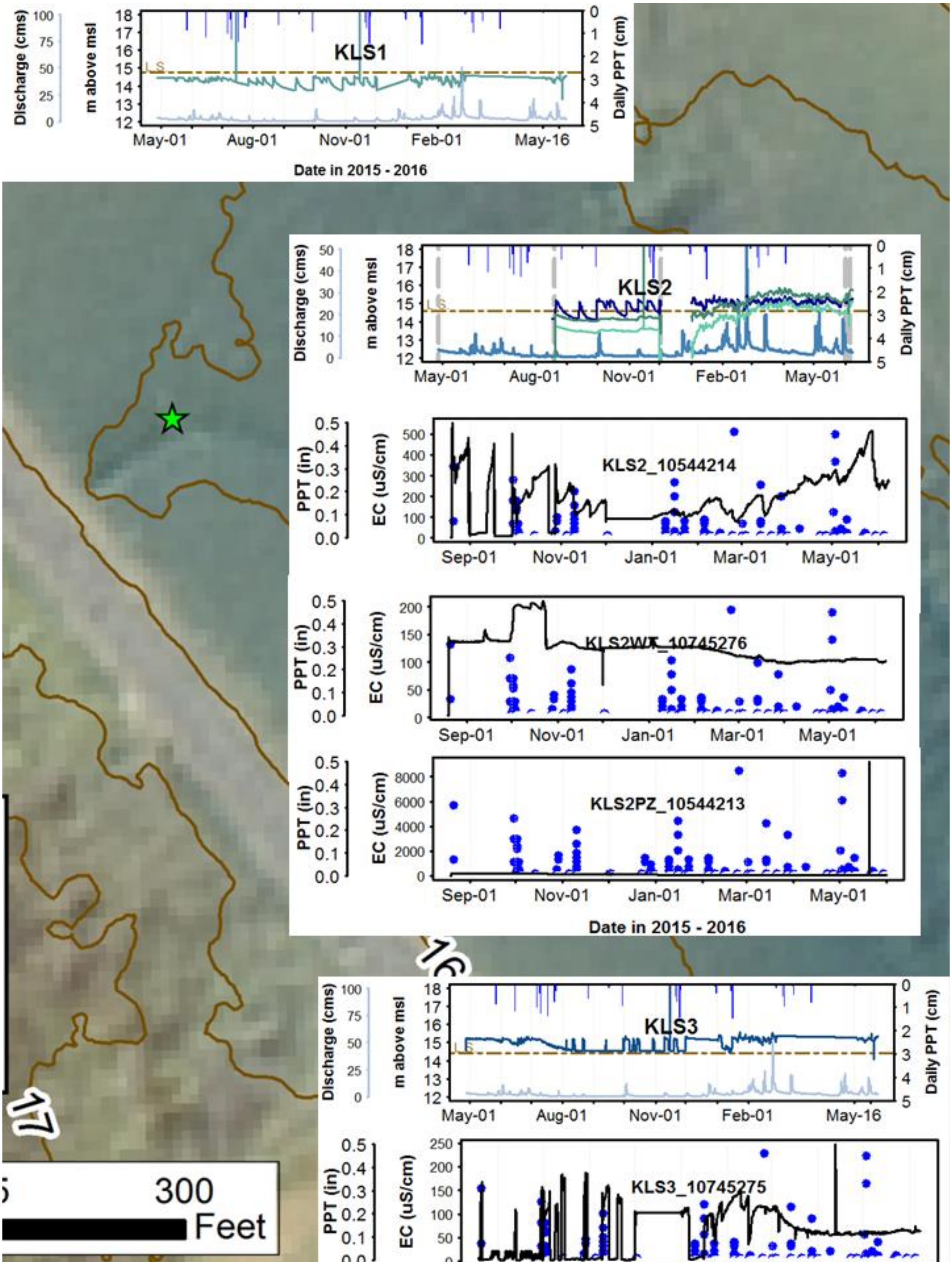


Figure 7. Water level measures (m above mean sea level) at the Klondike Road wetland field monitoring. Results combined with the continuous logger data showed a consistent flow in a southeast direction, from KLN1 toward KLS3, which is adjacent to Wooteneux Creek. Nested piezometer clusters located at the center of the wetland restoration (KLN2) ditch and an adjacent untreated ditch (KLS2) indicated groundwater upwelling and discharge.


KLN1
Discharge (cms)
m above msl
Daily PPT (cm)
May-01
Aug-01
Nov-01
Feb-01
May-16
KLN1_10544205
PPT (in)
EC (uS/cm)
Sep-01
Nov-01
Jan-01
Mar-01
May-01
Date in 2015 - 2016
KLN2-WT
KLN3_10544209
KLN2PZ_10745272
16.5
KLN3
KLN2WT_10544207



KLS1
Discharge (cms)
m above msl
Daily PPT (cm)
Date in 2015 - 2016
KLS2
KLS2_10544214
KLS2WT_10745276
KLS2PZ_10544213
PPT (in)
EC (uS/cm)
KLS3
KLS3_10745275
300
Feet

Conclusions and Lessons Learned

This project demonstrated a truly collaborative effort through the Talbot Ditch Restoration Partnership to improve water quality in a way that incorporates local landowner concerns, supports local government efforts toward meeting their watershed implementation plan goals and works toward developing a locally-led process to most efficiently and effectively use resources to achieve water quality goals. The grant supported TNC and CBF to catalyze these efforts by building support of the local community, developing the science to target practices, implementing a diversity of restoration design options, and instrumenting two sites to monitor hydrology and water quality. We are excited that the county has embraced this approach and is moving the framework forward to implement high priority sites through collaboration between the Talbot County Department of Public Works, Road Department, and the Soil Conservation District.

As demonstrated in Talbot County, a targeted ditch restoration strategy can support a cross-sector approach to achieving water quality that is cost effective and builds partnerships across county agencies. This approach is applicable to other counties across the Eastern Shore and even across the Chesapeake Bay watershed and beyond if local concerns and differences in landscape features are incorporated into the targeting approach. Based on our experience in Talbot, we offer the following lessons learned and considerations to help with future efforts.

- **Roadside ditches significantly influence regional water resources by altering the timing and magnitude of storm flow, exacerbating water quality concerns, and degrading habitat.** Results shared at the STAC workshop and also observed at the Unionville Road bioswale sites highlighted how roadside ditches provide important conduits and direct sources of impacts to streams and wetlands.

- **Targeting projects will achieve greater water quality outcomes at lower cost** – Nutrient and sediment loads and the ability of practices in different landscape positions vary widely across the county-scaled project area, as did costs. Identifying areas that will achieve the greatest water quality benefits will be more cost effective because fewer, more cost-effective practices will be needed to achieve a set goal.

- **Targeting practices to the best locations is supported by farmers and landowners –** Farmers and citizens in Talbot County were generally supportive of the idea of targeting practices to the most effective places. A simple and transparent targeting approach was also supportive so they could understand why certain places were identified as priorities and the information matched their understanding of how nutrients were moving across the landscape.

- **Need more information on different design efficiencies to accurately assess cost/ pound of nutrients and sediment removed** – project costs varied widely and our ability to estimate nutrient and sediment reductions was limited by the coarseness of available BMP efficiencies and therefore may not have been reflective of project designs. More information is needed to best design these types of practices for water quality benefits.

- **Trusted outreach and expedited project implementation is needed for success –** having a trusted person such as through the Soil Conservation District or an influential landowner/ farmer engage priority landowners to implement restoration projects is key to success. Additionally, once a landowner agrees to do a project, they expect the project to be designed and implemented in a reasonable timeframe. Clearly conveying the process and timeline ensures that expectations are realistic. Standard designs (such as the one developed for 2-stage roadside ditch by Talbot SCD) can expedite projects and reduce costs.

Literature Cited

Alhajjar, B., G. Chesters, and J.M. Harkin, 1990. Indicators of Chemical Pollution from Septic Systems. Ground Water 28:559–568.

Backstrom, M., U. Nilsson, K. HaKansson, B. Allard, and S. Karlsson, 2003. Speciation of Heavy Metals in Road Runoff and Roadside Total Deposition. Water, Air, and Soil Pollution and Soil Pollution 147:343–366.

Colman, S.M., J.P. Halka, C. Hobbs III, R.B. Mixon, and D.S. Foster, 1990. Ancient Channels of the Susquehanna River beneath Chesapeake Bay and the Delmarva Peninsula. Geological Society Of America Bulletin. doi:10.1130/0016-7606(1990)102<1268.

Cushing, E.M., I.H. Kantrowitz, and K.R. Taylor, 1973. Water Resources of the Delmarva Peninsula.

Deutsch, W.J., 1997. Groundwater Geochemistry: Fundamentals and Applications to Contamination J. Stein and A. W. Starkweather Jr. (Editors). CRC Press LLC, Boca Raton, FL.

Owens, J.P. and C.S. Denny, 1979. Upper Cenozoic Deposits of the Central Delmarva Peninsula, Maryland and Delaware: Surface and Shallow Subsurface Geologic Studies in the Emerged Coastal Plain of the Middle Atlantic States. Geological Survey Progessional Paper 1067-A.

Reybold, W.U., 1970. Soil Survey of Talbot County. :92.

Simpson, T. and S. Weammert, 2009. DEVELOPING BEST MANAGEMENT PRACTICE DEFINITIONS AND EFFECTIVENESS ESTIMATES FOR NITROGEN , PHOSPHORUS AND SEDIMENT IN THE CHESAPEAKE BAY WATERSHED Final Report December 2009.

Appendix A

Summary of Top 25 opportunities to mitigate impacts from roadside ditches along county roads in Talbot County, Maryland.

Ditch ID	Contributing Acres	Ditch Length (ft)	Cropland Acres	Forest Acres	Paved Acres	Urban Acres	TN Load (lbs/yr)	TP Load (lbs/yr)	TSS Load (lbs/yr)	TN Rank	TP Rank	TSS Rank	Rank Average	Ranked Priority
462	142.5	24074	134.8	0	0.9	6.8	11012	1623	26109	3	2	2	2.3	1
595	120.1	22400	117.7	0	1.8	0.6	1209	72	22590	6	16.5	15	12.5	2
511	106.3	15679	76.3	0	1.1	0.0	1028	54	19724	16	27.5	21	21.5	3
993	53.1	12665	25.9	0	1.1	11.7	1436	181	11479	45	12	11	22.7	4
952	87	16666	84.7	0	0.9	1.5	875	53	16462	23	29	30	27.3	5
658	76.2	16493	75.3	0	0.9	0.0	768	46	14252	30	33	36	33	6
956	75.3	14428	50.8	0	1.1	0.0	727	37	14116	32	46	37.5	38.5	7
610	82.2	14802	36.6	0	0.2	6.8	681	39	13652	34	41.5	43	39.5	8
437	64.5	10030	63.2	0	1.3	0.0	650	38	12159	39	43.5	46	42.8	9
573	62.7	9987	62.0	0	0.7	0.0	633	39	11727	43	41.5	48	44.2	10
500	64.8	10015	49.2	0	0.8	3.4	617	38	12121	40	43.5	50	44.5	11
965	64.4	11669	59.2	0	0.4	0.6	643	36	12119	41	49	47	45.7	12
20106	33.4	6468	30.7	0	0.7	1.7	3266	491	6048	134	6	6	48.7	13
30007	56.8	9092	54.4	0	1.4	1.0	569	35	10860	52	51	57	53.3	14
933	50.4	9511	33.2	0	0.7	16.4	471	36	11722	44	49	73	55.3	15
714	26	3956	22.9	0	0.6	1.8	1465	209	4966	160	10	10	60	16
1337	48.6	12409	47.8	0	0.8	0.0	488	30	9111	69	64.5	68	67.2	17
827	49.5	10058	47.0	0	1.2	0.8	494	28	9447	67	73.5	65	68.5	18
736	49	6412	16.2	0	0.2	12.8	413	29	10052	60	68.5	87.5	72	19
407	46.2	7089	45.1	0	0.8	0.3	466	28	8719	76	73.5	75	74.8	20
730	45.3	7622	43.9	0	0.4	1.0	455	28	8586	79	73.5	77	76.5	21
1057	42	10244	35.6	0	1.6	4.9	411	26	8693	77	81.5	89	82.5	22
898	41.3	6658	39.2	0	2.2	0.0	413	25	7966	87	86.5	87.5	87	23
906	37.8	6561	33.3	0	0.8	3.4	373	24	7585	92	93.5	105	96.8	24
775	38.2	6249	37.9	0	0.4	0.0	385	23	7137	107	99.5	96	100.8	25

Summary of the Talbot Ditch Restoration Partnership*
TNC/CBF grant funded project in Talbot County, Maryland
November 2013 through June 2016

A video describing the project is available for viewing at https://vimeo.com/130424563

The project involved developing a targeting tool to identify roadside ditch locations that would intercept the greatest nutrients and sediments and implementing a diversity of projects to demonstrate restoration options to landowners and local residents.

Targeting: Grantees used high resolution topography data (1 to 2 m horizontal resolution; 15 cm vertical resolution) to identify concentrated flow channels throughout Talbot County that drain to roadside ditches along county roads and to delineate local contributing areas that influence the quantity and quality of surface waters in a channel. Edge-of-stream delivered loads of TN, TP, and TSS were estimated based on loading rates predicted by the CBP watershed model specific to land use and land cover conditions within the local contributing area. Retention benefits were calculated using BMP efficiencies. Results identified more than 1,000 ditch treatment opportunities along county roads.

Demonstration projects: Grantees constructed eight demonstration projects. BMPs included pocket/bench wetlands, two-stage ditches, grass waterways, grass buffers and bioswales. Nutrient and sediment retention benefits were estimated using information provided by the CBP and MD Trust Fund. Load reductions related to the conversion of land use from agriculture to wetland or buffer were also calculated. Estimates of costs per pound of P removed ranged from $596 to $103,980. Limited monitoring data provided in grant report.

<u>Lessons Learned from the Grantees (taken directly from grant report):</u>

1) Roadside ditches significantly influence regional water resources by altering the timing and magnitude of storm flow, exacerbating water quality concerns, and degrading habitat. Results shared at the STAC workshop and also observed at the Unionville Road bioswale sites highlighted how roadside ditches provide important conduits and direct sources of impacts to streams and wetlands.
2) Targeting projects will achieve greater water quality outcomes at lower cost – Nutrient and sediment loads and the ability of practices in different landscape positions vary widely across the county-scaled project area, as did costs. Identifying areas that will achieve the greatest water quality benefits will be more cost effective because fewer, more cost-effective practices will be needed to achieve a set goal.
3) Targeting practices to the best locations is supported by farmers and landowners – Farmers and citizens in Talbot County were generally supportive of the idea of targeting practices to the most effective places. A simple and transparent targeting approach was also supportive so they could understand why certain places were identified as priorities and the information matched their understanding of how nutrients were moving across the landscape.
4) Need more information on different design efficiencies to accurately assess cost/ pound of nutrients and sediment removed – project costs varied widely and our ability to estimate nutrient and sediment reductions was limited by the coarseness of available

BMP efficiencies and therefore may not have been reflective of project designs. More information is needed to best design these types of practices for water quality benefits.

5) Trusted outreach and expedited project implementation is needed for success – having a trusted person such as through the Soil Conservation District or an influential landowner/ farmer engage priority landowners to implement restoration projects is key to success. Additionally, once a landowner agrees to do a project, they expect the project to be designed and implemented in a reasonable timeframe. Clearly conveying the process and timeline ensures that expectations are realistic. Standard designs (such as the one developed for 2-stage roadside ditch by Talbot SCD) can expedite projects and reduce costs.

*Prepared by Ann Jennings, Chesapeake Bay Commission

Appendix 10. Draft Technical Memo, Chesapeake Bay Roadside Ditch Management Team

Draft Technical Memo

Date: May 22, 2017

From: Chesapeake Bay Roadside Ditch Management Team

Jeff Allenby, Chesapeake Conservancy
Steve Bloser, PSU Center for Dirt and Gravel Road Studies
Chris Brosch, DE Dept of Agriculture
Kathleen Boomer, Nature Conservancy
Eric Chase, PSU Center for Dirt and Gravel Road Studies
Reid Christianson, Center for Watershed Protection
Mark Dubin, University of Maryland
Clint Gill, DE Dept of Agriculture
Jeremy Hanson, Virginia Tech
Lucinda Power, US EPA CBPO
Tim Rosen, Mid Shore River Keeper
Rebecca Schneider, Cornel University
Bill Wolinski, Talbot County DPW (MD)

To: Urban Stormwater Work Group and Agricultural Workgroup

Re: Draft Options for Crediting Pollutant Reduction from Roadside Ditch Management Practices (RDM) in the Chesapeake Bay Watershed

Section 1. Background and Purpose of Memo

The Scientific and Technical Advisory Committee (STAC) released a research report on improving roadside ditch management practices to meet TMDL water quality goals (Schneider and Boomer, 2016). One of the key report findings was that improved management of the roadside ditch network could be an effective pollutant reduction strategy in many rural and/or un-regulated portions of the Bay watershed. A short term RDM team was established to discuss a path forward for defining, crediting and verifying this group of practices (CSN, 2016).

The objectives for the RDM team were to:

1. Work on existing crediting options that could be applied to roadside ditches, based on more than a dozen existing or pending expert panel reports approved by the Chesapeake Bay Program over the last decade (See Appendix A).

2. Determine if any road-side ditch practices are not covered by existing or pending expert panel reports approved by the Chesapeake Bay Program, and have sufficient science to support a future expert panel (and what priority it should have in the overall BMP panel queue).

3. Evaluate how improved LiDAR mapping of the ditch and stream network in the watershed could assist in the assessment and crediting process.

4. Devise a strategy to increase implementation and reporting of RDM practices by engaging local and state highway agencies across the Bay watershed.

Section 2. Defining the Roadside Ditch Management Practice

The first step is to define the overall RDM practice and its subcategories in a manner that researchers and practitioners understand. This is not easy given the many different ways by which urban, suburban, rural, farm and forest ditch networks are designed and managed across the watershed.

Common Characteristics of Traditional Roadside Ditch Networks

Roadside ditches are used to convey stormwater away from roads and other areas and have a defined bed and side slopes. Traditional roadside ditch networks have many common characteristics:

- Ditches are primarily designed to move water away from roads, residential areas and farm fields, with very little regard for impacts to water quality or habitat.

- Ditches have widely different maintenance programs (i.e., design, frequency, and type of maintenance) which strongly influence conveyance function and downstream impacts

- Ditches can have widely variable impacts to downstream resources: Specific segments of a ditch network can act as a net "sink", "source" or "conduit" of sediment, nutrients, and/or other contaminants of concern, depending on their location, design, installation, and maintenance.

- The ditch network is poorly inventoried and mapped: There is an urgent need to develop a comprehensive inventory of roadside ditches to identify where more complex maintenance strategies are needed to reduce hydrologic connectivity between up-gradient contaminant sources and downstream regional water supplies.

Throughout the entire Chesapeake Bay watershed, in forested, agricultural, and developed landscapes, roadside ditches significantly influence regional water supplies through effects on the quantity, quality, and timing of surface water discharge.

Background:

In forested regions, roadside ditches often capture sediment-rich runoff from unimproved roads. Further, the slope and its direction and aspect can increase the rate of surface water discharge, thereby concentrating erosive power and impacts to down-gradient streams. In other rural areas, including agricultural and recreational lands and low density development, roadside ditches also can impose significant impacts to downstream waterbodies.

Recommendations for mitigating impacts from roadside ditches highlight that a range of practices, in terms of complexity and costs, can be applied to disconnect "rural stormwater systems." Where possible, eliminating rural roadside ditches through basic maintenance improvements is often the most effective and economical way to reduce sediment pollution. Alternative low-cost practices focus on cover management and can be applied universally throughout counties and watersheds to enhance infiltration, and to reduce runoff and sediment pollution to streams.

Roadside ditches that carry a high volume of contaminated waters may require more expensive, engineered practices. If advanced ditch management or elimination is not possible, it is possible to reduce the slope-length of the ditches or road surface by increasing the available drainage outlets and diffuse concentrated flows and runoff delivered to the ditch or stream network through buffers or other natural filters.

Note on Agricultural Ditches:

The agricultural sector has long realized that the ditch network draining farm fields and animal feeding operations is an important location to treat the quality of agricultural runoff. Needelman et al (2010) provides a good summary of current approaches to utilize agricultural ditches to increase sediment and nutrient removal. Further, this panel recognizes that 1) agricultural ditches often connect with roadside ditches; and 2) recommendations for best agricultural ditch management practices are relevant to advancing roadside maintenance. While agricultural ditches share many characteristics with roadside ditches, however, they are not part of the charge of this RDM team.

Proposed Definitions of Roadside Ditch Management (RDM) Categories

Roadside ditch management (RDM) practices fall into 7 broad categories, as follows:

Category 1. Ditch Buffers: This practice restricts or excludes agricultural crop and livestock production from the public road right-of-way and its associated roadside ditch. Where public road right-of-ways are not sufficient to provide an adequate ditch buffer, the possibility of an incentivized narrow-width vegetative buffer (15 to 30 feet) on the adjacent private property could be explored. The permanent vegetative ditch buffer would function to prevent direct applications of fertilizer, manure or pesticides in the ditch zone that can be easily mobilized during storms. This is not a common incentivized practice at this time, although some narrow ditch buffers have been implemented on the Maryland eastern shore.

Category 2. Ditch Elimination: This practice involves eliminating a roadside ditch to:

(a) reduce or eliminate flow volumes introduced into streams
(b) reduce or eliminate sediment and nutrient runoff to streams
(c) disconnect the road network from the stream network.

Ditch elimination can be accomplished by a variety of road design/maintenance improvements such as raising the road profile, removal of berms, and out-sloping the road in order to move water directly from the road surface to areas where it can be infiltrated prior to reaching the stream network.

Category 3. Ditch and Road Slope-Length Reduction: This practice involves management techniques to reduce the length of the road segment and the ditch to:

(a) reduce flow volumes in the ditch
(b) reduce sediment and nutrient runoff to streams
(c) minimize the road connection to the stream network.

Ditch and road slope-length reductions can be accomplished by a variety of road design/maintenance improvements such as the addition of drainage cross pipes (culverts), turnouts (bleeders or lead-off ditches), broad-based dips or grade break

Category 4. *Ditch Stabilization*: Restore a failed ditch that has become an active source of sediment and nutrient loads that are exported to downstream waters. The practice involves stabilizing the banks and ditch channel and rapidly establishing dense vegetative cover to prevent further ditch erosion. Often referred to as "stabilized drainage way", this practice is frequently specified in most state erosion and sediment control manuals, new roadway and ditch construction criteria, and forest road design manuals.

Category 5. Ditch Maintenance: The practice involves routine removal of <u>mobile</u> sediments and organic matter that are trapped in the roadside ditch network (and safely disposed in upland areas of the watershed). The roadside ditch is adequately stabilized after sediment removal to prevent future ditch stabilization issues. Delivery is a key issue for this practice since only a small fraction of the sediment particles removed from a ditch are small enough to have any chance of ever reaching the Bay.

Category 6. Ditch Treatment: This practice treats the quality of ditch runoff in several ways:

(a) changing the soil media in portions of the ditch to promote greater pollutant removal, using soil amendments, standard bioretention media, biochar, water treatment residuals and other media enhancements (see Hirschman et al, 2017)

(b) installing "nutrient removal" check dams or in-ditch bioreactors. These bioreactors are explicitly designed to remove nitrogen and/or phosphorus by maximizing stormwater runoff reduction, N de-nitrification and P adsorption

(c) re-shaping a "V"-shaped ditch to more trapezoidal or two-stage dimensions, installing internal structures within the ditch to increase hydraulic residence time, and/or planting ditch vegetation to create wetland or meadow habitat conditions

Category 7. Ditch Retrofit: This practice creates stormwater treatment (ST) and/or runoff reduction (RR) by excavating additional runoff storage volume within an existing ditch segment. The storage can be provided on-line or off-line, and most ditch retrofits are typically sized to provide water quality treatment for 0.5 to 1.5 inches of impervious cover equivalent from the contributing drainage area. The following ditch retrofit options have been approved:

(a) Retrofit of existing stormwater conveyance systems

(b) Converting existing ditch to a dry swale, wet swale, bioretention area or sand filter

(c) Restoring ditch function by major sediment cleanout/vegetative harvesting

(d) Enhancing ditch via soil or media amendments

(e) Dry channel regenerative stormwater conveyance systems (for steeper ditches)

(f) Continuous monitoring and adaptive control (CMAC) retrofits

Section 3. Mapping and Assessing Roadside Ditch Characteristics

Given limited resources and the expansive length and impacts from roadside ditches, it is critical to identify and manage roadside ditches that connect contaminant sources and regional waterways most effectively, thus impose the most significant adverse impacts to water quality and habitat concerns. Recent widespread availability of high resolution topography, aerial photography, and land use land cover data provide a promising opportunity to map these local features across county jurisdictions and to prioritize locations for advanced roadside ditch management.

Despite limitations, hydrologically enforced LiDAR-derived topography data, with 1 to 2 m horizontal resolution and greater than 20 cm vertical accuracy, have been used successfully to map roadside ditches, delineating local contributing areas, and prioritize roadside ditch treatments. In Talbot County, MD, for example, more than 1200 locations were identified along county road only (i.e., not state or town roads). Desktop and field verifications provided additional support to identifying critical locations where grant funds were successfully secured to implement advanced practices.

While the high resolution analysis provides valuable information to road managers, it should be recognized that at present, the quality of the LiDAR DEMs varies throughout the Bay watershed, due in part to differences in how the LiDAR data were collected and processed by the various vendors. Poor quality data lacking hydrologic enforcement can significantly complicate efforts to map roadside ditch networks and to assess hydrologic connectivity.

Section 4. Options for Crediting Pollutant Reduction by RDM Practices

This section briefly describes which prior expert panels are relevant to each RDM category and outlines key challenges involved in developing crediting protocols.

Category 1: Ditch Buffers

No expert panel has specifically addressed ditch buffers, although the forestry work group recently re-evaluated removal rates for both forest and grass buffers in agricultural settings (Belt et al, 2014). The original expert panel expressed grass buffer removal as both a land use change (crop to hay w/o nutrients) and a unique removal rate for different physiographic regions of the Chesapeake Bay watershed. In addition, the panel relied on a standard buffer definition (NRCS Practice 391) which enables them to be cost-shared under CREP and other agricultural BMP programs for perennial or intermittent streams, wetlands, or other qualifying waterbodies (FSA CRP/CREP). The new expert panel concluded that there was not enough new scientific data on riparian and grass buffers to justify different removal rates at the present time (Belt et al, 2014).

It is possible that some, but not all, roadside ditches would meet the current USDA-FSA definition of perennial or intermittent streams, wetlands, or other qualifying waterbodies to qualify for CRP/CREP program incentives to establish and maintain roadside ditch buffers. Other current or new sources of financial and technical assistance may need to be considered for their establishment and maintenance on a wider scale.

Category 2: Ditch Elimination

A previous expert panel report on Dirt and Gravel Road ESC recommended sediment removal credits for several practices that are used to eliminate ditches (Klimkos et al, 2008). Sediment reductions of 15 to 55% for various combinations of these practices were recommended, but the actual research support was limited, and that approach is no longer recommended by forest road experts.

Instead, the Center for Dirt and Gravel Roads has proposed a new and improved method to estimate sediment reduction associated with ditch elimination. Sediment loads from a road segment can be easily estimated before and after ditches are eliminated for specific forest road locations using the US Forest Service - Water Erosion Prediction Project Road program (WEPP:Road) https://forest.moscowfsl.wsu.edu/fswepp/docs/fsweppdoc.html#wr). WEPP:Road was specifically designed to evaluate sediment delivery potential from forest roads due to various ditch elimination practices, such as raising the road profile or berm removal. Most users should be able to use this simple method to assess their ditch elimination projects. Please consult Appendix B for a design example on how the proposed credit might work.

Some significant challenges arise when it comes to crediting this RDM category:

- WEPP:Road cannot predict nutrient loads from ditch elimination and very little monitoring data is available to assess forest ditch nutrient loads. Consequently, it is doubtful that a nutrient reduction credit for ditch elimination could be technically supported.

- In the last eight years, no one has ever reported the dirt and gravel road erosion and sediment control practice for sediment credit in the Watershed Model. This suggests that road and highway agencies will need additional guidance on how to report the sediment credit (and to whom) in the future.

Category 3: Ditch and Road Slope-Length Reduction

A previous expert panel report on Dirt and Gravel Road ESC recommended sediment removal credits for several practices that are used to reduce the slope length of road ditches (Klimkos et al, 2008). This can involve installation of grade breaks, additional drainage outlets and other practices to break up slopes and shorten up the effective ditch length. The Center for Dirt and Gravel Roads has recently proposed a new and improved method to estimate sediment reduction associated reducing the slope-length of road ditches using WEPP:Road. The model is used to calculate sediment reductions from installing multiple drainage features to break up the slope length and outlet the water into forested buffers in situations where it is not physically possible to eliminate the ditch. Consult Appendix B for a design example on how the proposed credit might work.

This RDM category faces the same crediting challenges as those described for ditch elimination.

Category 4: Ditch Stabilization

The enhanced erosion and sediment control (ESC) expert panel recommended sediment removal credits for three levels of ESC technology utilized at construction sites (ESC EPR, 2014). Some of the practices reviewed could be applied to stabilization of eroding ditches whether they are located at a construction site or not. These include practices such as grass channels, dikes and stabilized drainage ways, along with supporting practices such as geotextile fabrics, floc bags, wattles, check dams and grass seeding. The ESC expert panel did not grant any nutrient reduction credit for ESC practices, given the very high fertilization rates needed to initially stabilize construction sites.

Several serious issues arise when it comes to crediting this RDM category:

- What numerical triggers would be needed to define when a ditch warrants stabilization to prevent it from becoming a severe sediment source to downstream land uses? (slope, depth of gully erosion, lack of vegetative cover, contributing drainage areas)

- What scientific data exists to support (a) a unique sediment loading rate for unstable ditches and (b) the corresponding sediment load reduction after they are stabilized?

- What land use would un-stabilized roadside ditches correspond to in the Phase 6 watershed model? (the choices are fairly limited: construction sites, pervious land and transport IC).

Category 5: Ditch Maintenance

Two previous expert panels have looked at the issue of crediting removal of sediment and attached nutrients from the storm drain and stream network. The first provided a sediment and nutrient credit for storm drain cleaning (SSDC EPR, 2016) for the measured volume of solids/organic matter that are effectively captured and properly disposed during catch basin cleanouts. The credit is extended to open-concrete lined channels but does not apply to sediment cleanouts to maintain un-lined ditches along open section roads (p, 47 of SSDC EPR, 2016). Default mass volume conversions and nutrient enrichment factors are provided to calculate load reductions, which must be supported by a standard operating procedure. Only a handful of communities have historically reported storm drain cleaning for credit.

The second report looks at the sediment and nutrient load reduction for bank sediments that are prevented from eroding due to urban stream restoration practices (USR EPR, 2013). The credit is described under Protocol 1 from that report, and requires field measurements of sediment loss and default rates for sediment nutrient enrichment.

There are several challenges involved in developing credits for routine ditch maintenance.

- Scientists have found it hard to define what sediment particle sizes are "mobile" in the Bay watershed and can reach the estuary and which ones will never get there. Roadway maintenance crews find it hard to estimate the particle size of the material they muck out of ditches, without expensive laboratory sediment testing. The street cleaning expert panel noted that crediting protocols based on sediment mass volume are extremely sensitive to their input assumptions. Resulting load reduction estimates can vary by as much as three orders of magnitude for the same conditions (SSDC EPR, 2016). For this reason, that panel rejected the mass-based crediting approach in favor of one that relied on a more sophisticated engineering model.

- While the particle size distribution and nutrient content of street dirt and hopper waste appear to be fairly universal, there does not appear to be much actual monitoring data to define these parameters for roadside ditch sediments (although it is hard to think of a reason why street dirt and roadside ditch sediments would behave differently).

Category 6: Ditch Treatment

While this RDM category has not been the focus of a prior expert panel, it is actively being investigated by both the agricultural and urban workgroups. On the agricultural side, an expert panel was launched in August of 2016 to explore whether a list of innovative agricultural ditch management practices could be credited for pollutant removal within the context of the Chesapeake Bay watershed model. The new panel is evaluating two stage ditch design, in-ditch bioreactors, use of phosphorus absorbing materials, and other practices to increase nutrient processing in the ditch network.

On the urban side, it may be possible to credit them using the methods approved for new state stormwater performance standard expert panel (NSSPS EPR, 2013), especially when the physical dimensions of existing ditches are manipulated to achieve higher water quality functions. The expert panel developed simple adjustor curves to estimate removal rates based on the stormwater treatment or reduction volume provided by the upgrade. It should not be too difficult to adapt the curves to handle ditch treatment, but states and locals will need more detailed guidance and outreach on how to properly calculate the credit. In addition, the USWG is currently considering whether to credit performance enhancing devices (PEDs) for bioretention and dry swale retrofits (Hirschman et al, 2017). Several PEDs, such as media filter amendments and internal water storage zones, may apply to several RDM categories, such as ditch retrofit and treatment.

This RDM practice has fewer crediting problems than other categories, but still has a few technical issues. The foremost issue is when a ditch receives runoff from the road and adjacent non-urban land. Appendix D presents a method to define the equivalent impervious area so that the adjustor curves can be used. In addition, clarification is needed on which sector would "earn" the actual credit (i.e., agricultural, forest or urban pervious.

On a more practical level, detailed design and construction criteria for ditch treatment practices need to be developed so that highway and stormwater agencies can design, review and verify them.

Category 7: Ditch Retrofits

Prior expert panels have provided extensive guidance on swale and ditch retrofits. The primary one has been the stormwater retrofit panel (SR EPR, 2013) but several other panels have expanded on other possible ditch retrofit options (USR EPR, 2013, NSSPS, EPR 2013, UFS, 2014 and ICD, 2017). The procedures for crediting ditch retrofits all involve some variation of the retrofit adjustor curves, which are well established and documented. Some substantial work will need to be done to provide design examples and technical guidance on ditch retrofits crediting protocols for the highway engineering community.

The main challenge for crediting this RDM category involves how to deal with ditches with non-urban land in their contributing drainage area. Reid Christianson has developed a simple method to use runoff coefficients to define equivalent impervious area so that the adjustor curvets can be applied to non-urban drainage areas. His method is described in more detail in Appendix D. Some additional technical outreach may be needed to train state and local highway agencies on these new methods.

Section 6. RDM Team Recommendations for Going Forward

The team considered four options for crediting RDM practices.

Option 1: Launch a New Expert Panel. The Chesapeake Bay Partnership has continuously refined its protocol for reviewing the sediment and nutrient removal capability of new and existing BMPs for all watershed sectors (WQGIT, 2015). The protocol places a strong emphasis on the rigorous review of research, monitoring data and engineering models to derive defensible removal rates. The protocol also requires clear practice definitions and methods to report, track and verify any BMPs that are credited in the Phase 6 watershed model. Consequently, most expert panels take at least a year to reach consensus and several more months to get full approval by the CBP partnership.

Option 2: Add to the Charge of Ongoing Expert Panels. The agricultural workgroup has launched an expert panel on agricultural ditch management practices which could conceivably address RDM categories that occur on agricultural land. However, the expert panel is not designed nor staffed to evaluate and form recommendations for public road right-of-way ditches and their management.

Option 3: Conduct a Threshold Review. The work groups can conduct a "threshold" literature review to ascertain if there is sufficient BMP monitoring data and/or engineering models to warrant launching a new panel. In several cases, these reviews concluded that such data were lacking and the work group decided against launching a panel.

Option 4: Map RDM Practices into Existing Expert Panel Reports. The USWG recently developed a formal process to determine whether certain BMP variations or innovations could be interpreted or classified in the context of existing expert panel reports (Schueler, 2016). This can be an attractive option as it reduces the time and resources needed to make crediting decisions.

The RDM team concluded that different crediting options will be needed for the different RDM categories, and recommended that further follow up work be conducted by the appropriate work groups, as outlined in Table 1 below:

Table 1 Recommended Crediting Options for RDM Practices

RDM Category	Pollutants	Crediting Difficulty	Available Protocol?	Recommended Option	WG?
Buffer	S? N, P	Moderate	Land Use Change?	Option 2	A
Elimination	S only	Easy	WEPP-Road	Option 4	A/U
L/S Reduction	S only	Easy	WEPP-Road	Option 4	A/U
Stabilization	S only	Moderate	ESC Level 2	Option 3	U
Maintenance	S, N? P?	Hard	Storm Drain Cleanout	Option 3	U
Treatment	S, N, P	Easy	Adjustor Curves	Option 4	A/U
Retrofit	S, N, P	Easy	Adjustor Curves	Option 4	U

S: Sediment N: Total Nitrogen P: Total Phosphorus
WG: Work Group A: Agriculture U: Urban

The RDM team recommends that the urban and agricultural work groups develop a crediting approach for each practice by the summer 2018. This will provide state and local governments with more options to include RDM practices as they develop and execute their Phase III Watershed Implementation Plans.

The RDM team further recommends that resources be allocated to provide outreach and technical support to key stakeholders to implement RDM practices more widely and increase awareness among local and state highway and road agencies. As RDM crediting protocols are developed to meet Chesapeake Bay TMDL goals, these key stakeholders will need more detailed guidance on how to implement RDM practices more widely.

References Cited

Belt, K. et al. 2014. Report of the Expert Panel to Reassess Removal Rates for Riparian and Grass Buffers Best Management Practices. Prepared for Forestry Work Group. Chesapeake Bay Program.

Bloser, S., D. Creamer, C. Napper, B. Scheetz and T. Ziegler. 2012. Environmentally sensitive road maintenance practices for dirt and gravel roads. Center for Dirt and Gravel Road Studies. Pennsylvania State University. University Park, PA.

Chesapeake Stormwater Network. 2016a. Path forward for crediting pollutant removal from roadside ditch management practices. For Chesapeake Bay Program Office. Revised December 6, 2016

Chesapeake Stormwater Network. 2016b. Visual indicators for inspecting and verifying grass channels, filter strips and sheet flow to buffers. Webcast powerpoint. Chesapeake Bay Stormwater Training Partnership. October, 2016.

Erosion and Sediment Control Expert Panel Report (ESC EPR). 2014. Recommendations of the Expert Panel to Define Removal Rates for Erosion and Sediment Control Practices. Approved by the CBP WQGIT. April 2014.

Hirschman, D., Brian Seipp and T. Schueler. 2017. Performance enhancing devices for stormwater best management practices. Final Technical Report. Chesapeake Stormwater Network and Center for Watershed Protection.

Klimkos, M., D. Scheetz, T. Simpson and S. Weammert. 2008. Dirt and gravel road ESC: definition and nutrient and sediment reduction effectiveness estimates. Chesapeake Bay Program Nutrient Committee. EPA. Annapolis, MD,

Schueler, T. 2016. Process for handling urban BMP decision requests. Approved by Urban Stormwater Workgroup. February, 2016. Chesapeake Bay Program Office.

Street and Storm Drain Cleaning Expert Panel Report (SSDC EPR, 2016). Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices. Approved by the CBP WQGIT. May, 2016.

Needelman, B., A. Allen, P. Kleinman and R. Bryant. 2010. Managing Delmarva agricultural drainage ditches for water quality protection. University of Maryland. College of Agriculture and Natural Resources. College Park, MD.

New State Stormwater Performance Standards Expert Panel Report (NSSPS EPR). 2013. Recommendations of the Expert Panel to Define Removal Rates for State Stormwater Performance Standards. Approved by the CBP WQGIT. March 2013

Schneider, R. and K. Boomer. 2016. Re-plumbing the Chesapeake Watershed: Improving roadside ditch management to meet TMDL water quality goals. STAC Publication No. 16-001. Edgewater, MD -

Stormwater Retrofit Expert Panel Report (SR EPR). 2013. Recommendations of the Expert Panel to Define Removal Rates for Individual Stormwater Retrofit Practices. Approved by the CBP WQGIT. March, 2013.

Urban Filter Strip Expert Panel Report (UFS EPR). 2014. Recommendations of the Expert Panel to Define Removal Rates for Urban Filter Strips. Approved by the CBP WQGIT. June, 2014.

Urban Stream Restoration Expert Panel Report (USR EPR). 2013. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Approved by the CBP WQGIT. April, 2013.

Water Quality Goal Implementation Team (WQGIT). 2015. Revised protocol for the development, review and approval of loading and effectiveness estimates for nutrient and sediment controls in the Chesapeake Bay Watershed Model. US EPA Chesapeake Bay Program. Annapolis, MD.

Appendix A
List of Past and Pending CBP Expert Panel Reports
Related to Various Ditch Management Practices

BMP	Notes	Status
Agricultural Ditch BMP	Ag (Gill and Brosch)	Launched 8/30/2016
Water Controlled Structures	Ag	Approved
Phosphorus-absorbing Systems	Ag	Interim
Grass Buffer Strips	Ag	Approved
Dry Channel Regenerative Stormwater Conveyance	Urban Retrofit EPR Stream Restoration EPR	Approved
Retrofit of Existing Stormwater Conveyance System	Urban Retrofit EPR	Approved
Swale Enhancements (media)	Urban Retrofit EPR	Approved
Swale Conversions (dry swale)	Urban Retrofit EPR	Approved
Swale Restoration	Urban Retrofit EPR	Approved
Dry Swale, Wet Swale, Bioretention, Grass Channel, Constructed Wetlands	New State Stormwater Performance Standards EPR	Approved
Soil Amendment	ICD EPR	Conditionally Approved
Filter Strips	Urban Filter Strip EPR	Approved
Traditional ESC Practices (Stabilized Drainage Ways)	Enhanced Erosion and Sediment Controls EPR	Approved
ESC for Dirt and Gravel Roads	Scenario Builder Appendix	Approved in 1999
Lined Ditch Sediment Cleanout	Street/Storm Drain Cleaning EPR	Approved

Appendix B.
Proposed Crediting Method for Ditch Elimination and Slope Length Reduction Using WEPP: Road (Source: CDGRS, 2017)

Ditch Elimination: Erosion from a 400 foot long unpaved road segment in York County was simulated to show how WEPP:Road works and the benefits of ditch elimination and breaking up slope length. Figure 2 shows the sediment erosion output from an in-sloped road where water is collected in a single bare ditch and outletted to a 100 foot long forested buffer as a point source. The total sediment leaving the forested buffer is 983 lbs per year. Figure 3 shows that by out-sloping the road and eliminating the ditch the total sediment leaving the buffer drops to 307 lbs per year, a reduction of 69%.

Ditch flow-length Reduction: Figure 4 shows the benefits of adding an extra cross-pipe to the insloped road with a single bare ditch simulated in Figure 2. The road was broken up into two, 200 foot long road segments and each segment produced a total of 344 lbs of sediment per year leaving the buffer or 688 lbs for a 400 foot long segment. By breaking up the original 400 foot long slope length and making no other improvements, the amount of sediment leaving the buffer was reduced by 30%.

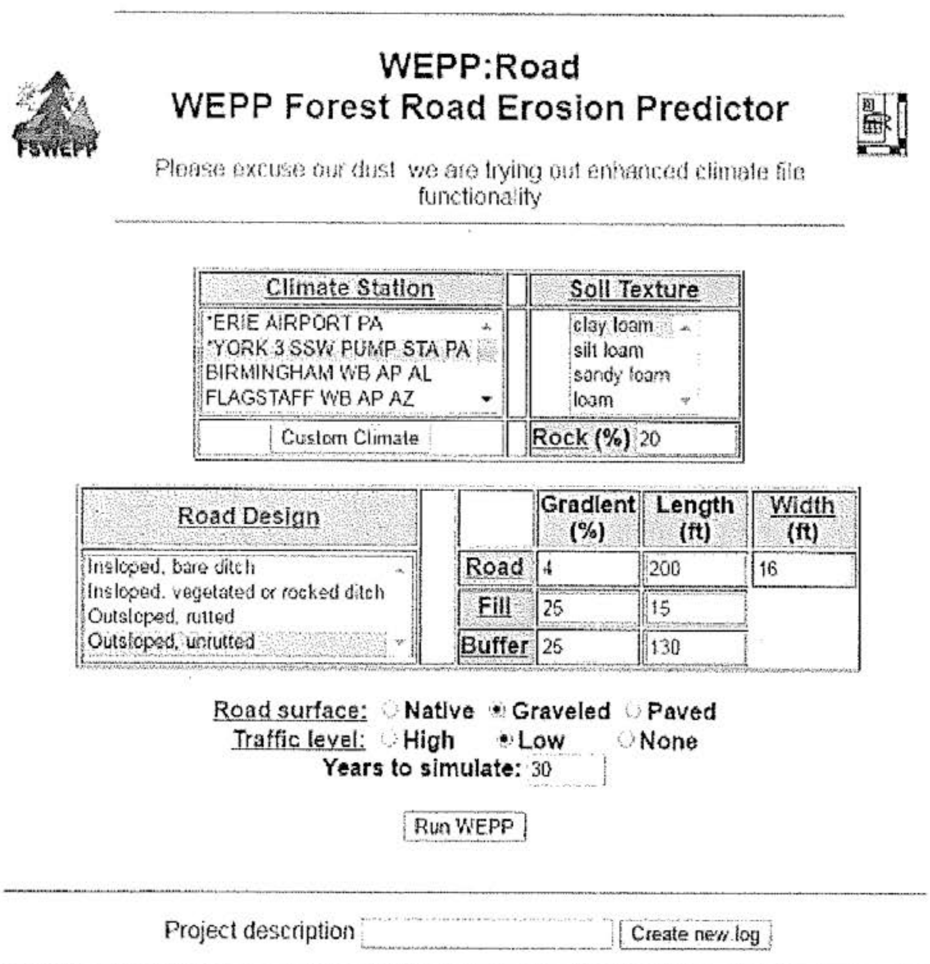


Figure 1. Screen shot of WEPP-Road input screen.

WEPP:Road Results

INPUTS			
Climate	YORK 3 SSW PUMP STA PA		
Soil texture	silt loam with 20% rock fragments (road: 85%; fill: 42.5%; buffer: 20% rock)		
Road design	Insloped, bare ditch		
Surface, traffic	graveled surface, low traffic		
	Gradient (%)	Length (ft)	Width (ft)
Road	4	400	16
Fill	25	15	
Buffer	25	100	

30 - YEAR MEAN ANNUAL AVERAGES

			Total in 30 years	
41.05	in	precipitation from	3738	storms
1.83	in	runoff from rainfall from	499	events
0.10	in	runoff from snowmelt or winter rainstorm from	105	events
1073.79	lb	road prism erosion		
983.38	lb	sediment leaving buffer		

Run description: Add to log

Figure 2. Sediment erosion output from 400 foot long road segment with inslope ditch. Total sediment leaving the buffer is 983 lbs per year.

WEPP:Road Results

INPUTS			
Climate	YORK 3 SSW PUMP STA PA		
Soil texture	silt loam with 20% rock fragments (road: 65%; fill: 42.5%; buffer: 20% rock)		
Road design	Outsloped, unrutted		
Surface, traffic	graveled surface, low traffic		
	Gradient (%)	Length (ft)	Width (ft)
Road	4	400	16
Fill	25	15	
Buffer	25	100	

30 - YEAR MEAN ANNUAL AVERAGES				
			Total in 30 years	
41.05	in	precipitation from	3738	storms
0.31	in	runoff from rainfall from	510	events
0.00	in	runoff from snowmelt or winter rainstorm from	101	events
824.03	lb	road prism erosion		
306.95	lb	sediment leaving buffer		

Run description [ ] [Add to log]

Figure 3. Sediment erosion output from 400 foot long road segment after outsloping the road and eliminating the ditch. Total sediment leaving buffer is reduced from 983 lbs to 307 lbs per year with ditch elimination (69% reduction).

WEPP:Road Results

INPUTS			
Climate	YORK 3 SSW PUMP STA PA		
Soil texture	silt loam with 20% rock fragments (road: 65%; fill: 42.5%; buffer: 20% rock)		
Road design	Insloped, bare ditch		
Surface, traffic	graveled surface, low traffic		
	Gradient (%)	**Length (ft)**	**Width (ft)**
Road	4	200	16
Fill	25	15	
Buffer	25	100	

30 - YEAR MEAN ANNUAL AVERAGES

			Total in 30 years	
41.05	in	precipitation from	3738	storms
1.27	in	runoff from rainfall from	493	events
0.04	in	runoff from snowmelt or winter rainstorm from	104	events
494.13	lb	road prism erosion		
344.00	lb	sediment leaving buffer		

Run description: [ ] Add to log

Figure 4. Sediment erosion output after breaking the 400 foot long segment from Figure 2into two 200 foot long road segments while maintaining inslope ditch. Breaking up slope length decreases erosion from 983 lbs per year to 688 lbs per year for a 400 foot long segment (30% reduction).

APPENDIX C:
ROSEN IDEAS ON DITCH CATEGORIES

When I read through the memo the one area that made me stumble was how to easily tie together *B. Proposed Definition for Roadside Ditch Management (RDM)* in section 2 to section 5. This might be due to my lack of knowledge on the various expert panels or due to by ag centric ditch view I have from working on the Eastern Shore. I am not sure if this would be helpful moving forward, but for me it helped me better understand potential crediting when I broke road side ditches into three subcategories:

1) Roadside ditches designed exclusively for stormwater
   a. Created during the construction of the road
   b. Generally low in TN, have high sediment transport capacity if there is poor maintenance
   c. Generally do not help drain larger areas other than the road and adjacent areas
   d. Ephemeral-run during storm events or very wet periods only
2) Roadside ditches for the conveyance of streams
   a. Road built near stream and ditch was created to channelize stream
   b. Help reduce flooding of road and to move stormwater generated from road
   c. Drain larger areas and can be intermittent to perennial depending on stream size and physiographic region
   d. High erosion potential, TN/TP levels based on dominant land use in watershed and not by road
3) Roadside ditches connected to existing agricultural ditches
   a. Agricultural ditch network pre-existed road and road uses the agricultural ditch to move stormwater
   b. Primary purpose is to lower water table for farming purposes, not for road stormwater
   c. Can drain a small or large area
   d. TN/TP levels dictated by ag fields, erosion potential is generally low if good farming practices are used, but can be very high if poorly vegetated or if land is tilled up to the ditch.
   e. Generally in flat landscapes

This framework helped me better visualize where potential ditch BMPs fit and might help identify which option is best for crediting.

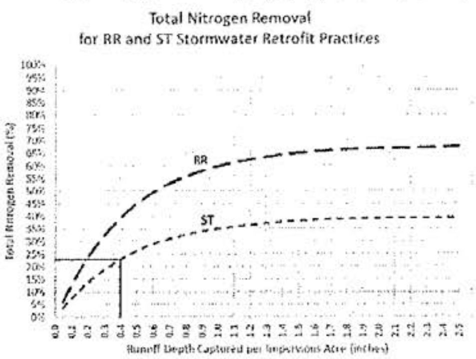
Appendix D.
Proposed Method for Runoff Equivalent Impervious Area for Non Urban Land Uses

The use of runoff coefficients can be use do normalize non-impervious drainage areas to an "runoff equivalent impervious area". For example, impervious has an Rv of 0.95, ag may have an Rv of 0.50, meaning 1 acre of ag would be "runoff equivalent" to roughly 0.53 acres of impervious (0.50/0.95=0.53).

Putting this into equation form, $I_{equivalent} = \frac{Rv_{contributory\ land\ use}}{Rv_{impervious}} * A_{contributory}$. where $I_{equivalent}$ is the equivalent impervious area, $Rv_{contributory\ land\ use}$ is the runoff coefficient of the drainage area, $Rv_{impervious}$ is the runoff coefficient of impervious (0.95), and $A_{contributory}$ is the size of the drainage area.

Water treatment volumes (i.e. cubic feet of water treated) for a specific BMP would be put in terms of volume treated per runoff equivalent impervious acre for direct use in the retrofit adjustor curves.

To further the above example, 1 acre of agricultural land (0.53 acres of runoff equivalent impervious) routed into a stormwater treatment (ST) ditch retrofit project providing 775 cubic feet of treatment would provide 0.4 inches of treatment. Using the runoff adjustor curves, the retrofit practice would provide 23%, 36%, and 46% reductions in TN, TP, and TSS, respectively. These reduction percentages would be applied to the load delivered by the drainage area.



Runoff coefficients can be gleaned from a number of sources. Here, runoff coefficients from Table 3.24 of Haan, Barfield, and Hayes (1994 -- Design Hydrology and Sedimentology for Small Catchments) are shown as an example.

Character of surface	Runoff coefficients
Streets	
Asphaltic and concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns; sandy soil	
Flat, 2%	0.05 to 0.10
Average, 2 to 7%	0.10 to 0.15
Steep, 7%	0.15 to 0.20
Lawns, heavy soil	
Flat, 2%	0.13 to 0.17
Average, 2 to 7%	0.18 to 0.22
Steep, 7%	0.25 to 0.35

Note: The coefficients in these two tabulations are applicable for storms of 5-year to 10-year frequencies. Less frequent higher intensity storms will require the use of higher coefficients because infiltration and other losses have a proportionally smaller effect on runoff. The coefficients are based on the assumption that the design storm does not occur when the ground surface is frozen.

Table 3.24—Continued

Rural areas			
	Soil texture		
Topography and vegetation	Open sandy loam	Clay and silt loam	Tight clay
Woodland			
Flat 0-5% slope	0.10	0.30	0.40
Rolling 5-10% slope	0.25	0.35	0.50
Hills 10-30% slope	0.30	0.50	0.60
Pasture			
Flat	0.10	0.30	0.40
Rolling	0.16	0.36	0.55
Hilly	0.22	0.42	0.60
Cultivated			
Flat	0.30	0.50	0.60
Rolling	0.40	0.60	0.70
Hilly	0.52	0.72	0.82

To generalize, the following categories with corresponding runoff coefficients are proposed:

Land Use/Cover	HSG A/B	HSG C	HSG D
Urban Pervious	0.12	0.18	0.22
Woodland (<5% slope)	0.10	0.30	0.40
Woodland (>5% slope)	0.27	0.42	0.55
Pasture (<5% slope)	0.10	0.30	0.40
Pasture (>5% slope)	0.20	0.40	0.57
Cultivated (<5% slope)	0.30	0.50	0.60
Cultivated (>5% slope)	0.46	0.66	0.76

This can be further refined to "runoff equivalent impervious" where 1 acre of the given land use equals this many acres of impervious:

Land Use/Cover	HSG A/B	HSG C	HSG D
Urban Pervious	0.13	0.19	0.23
Woodland (<5% slope)	0.11	0.32	0.42
Woodland (>5% slope)	0.28	0.44	0.58
Pasture (<5% slope)	0.11	0.32	0.42
Pasture (>5% slope)	0.21	0.42	0.60
Cultivated (<5% slope)	0.32	0.53	0.63
Cultivated (>5% slope)	0.48	0.69	0.80

Appendix 11. Background Research for Subcommittee 2: Tiered stormwater management

This work involved determining what the impervious cover in rural coastal localities is currently and how the proposed tiers of stormwater management might affect them. This was accomplished using the latest landcover information from the Virginia Geographic Information Network.

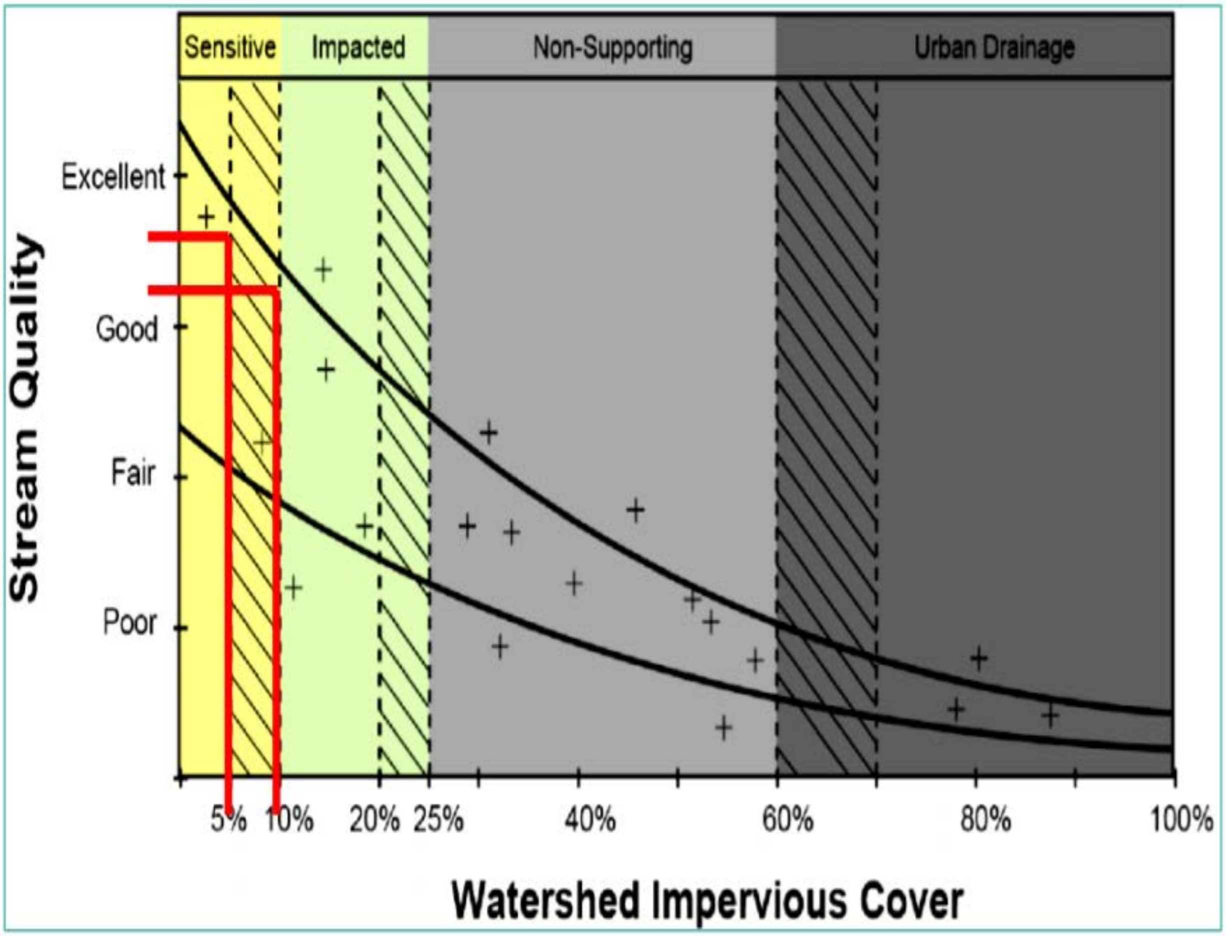
i. FINDINGS

After examination of multiple scales at which determinations might be made, and the most widely acceptable method for delineating management areas it was concluded that the level 6 watersheds mapped in the Virginia National Watershed Boundary Dataset would be “official”, practical, and easily available.

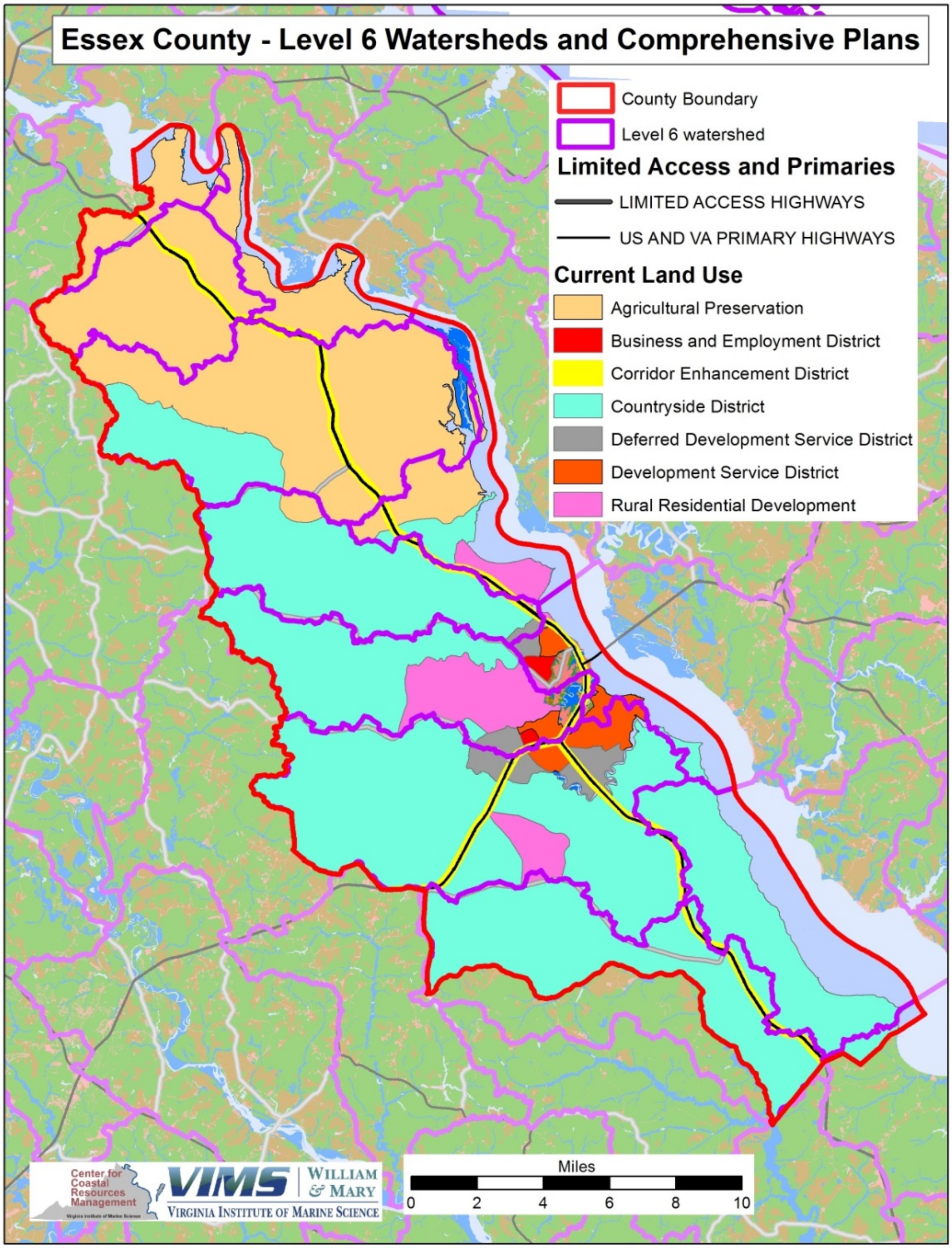
The current landcover information from VGIN indicates that for rural coastal localities in Virginia, the majority of level 6 watersheds have impervious cover well below the 5% threshold suggested by the Schueler et al. 2009 analysis.

Essex and Middlesex counties were examined for the preliminary assessment.

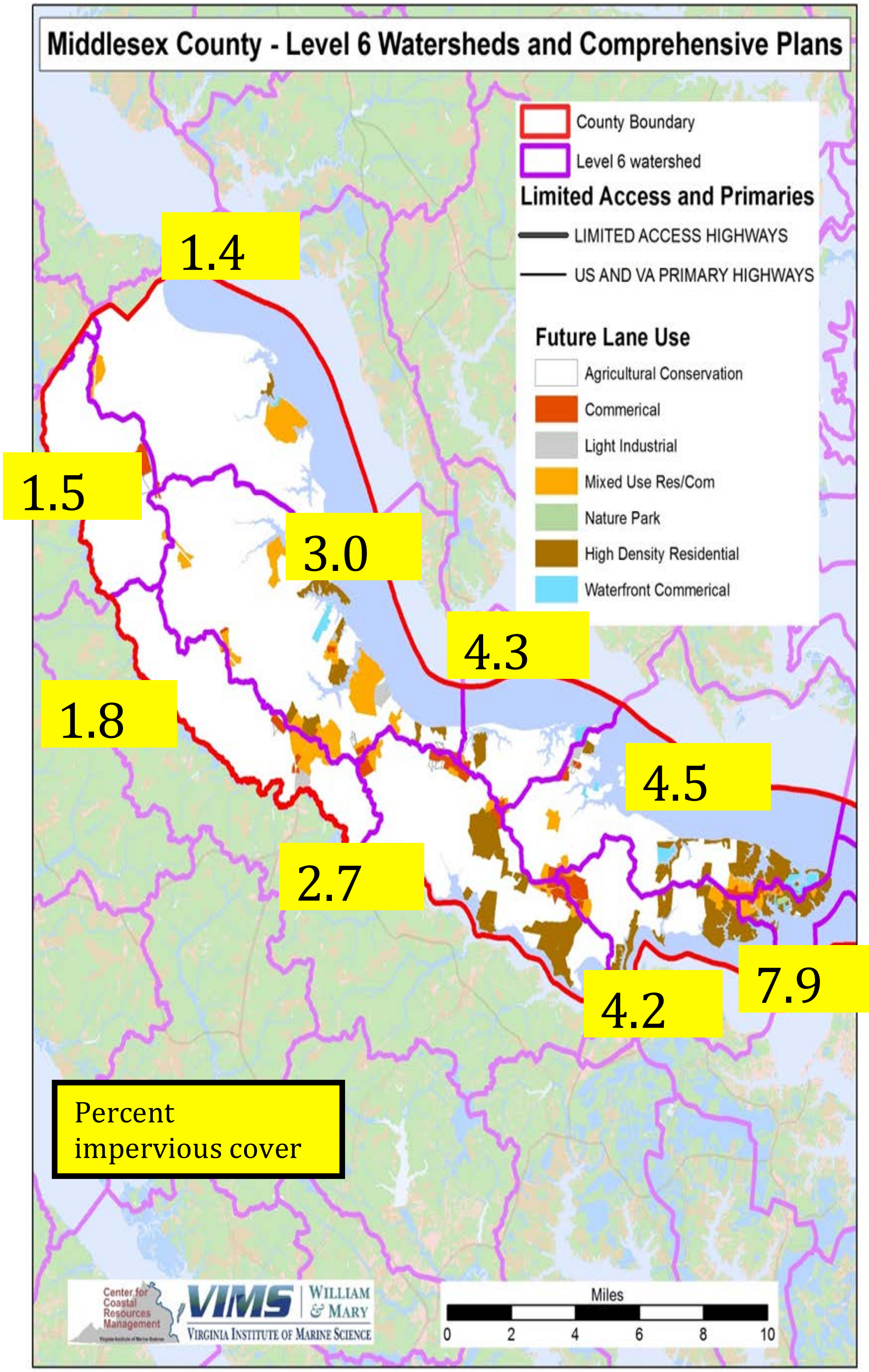
Information for evaluation of the tiered approach to storm water management

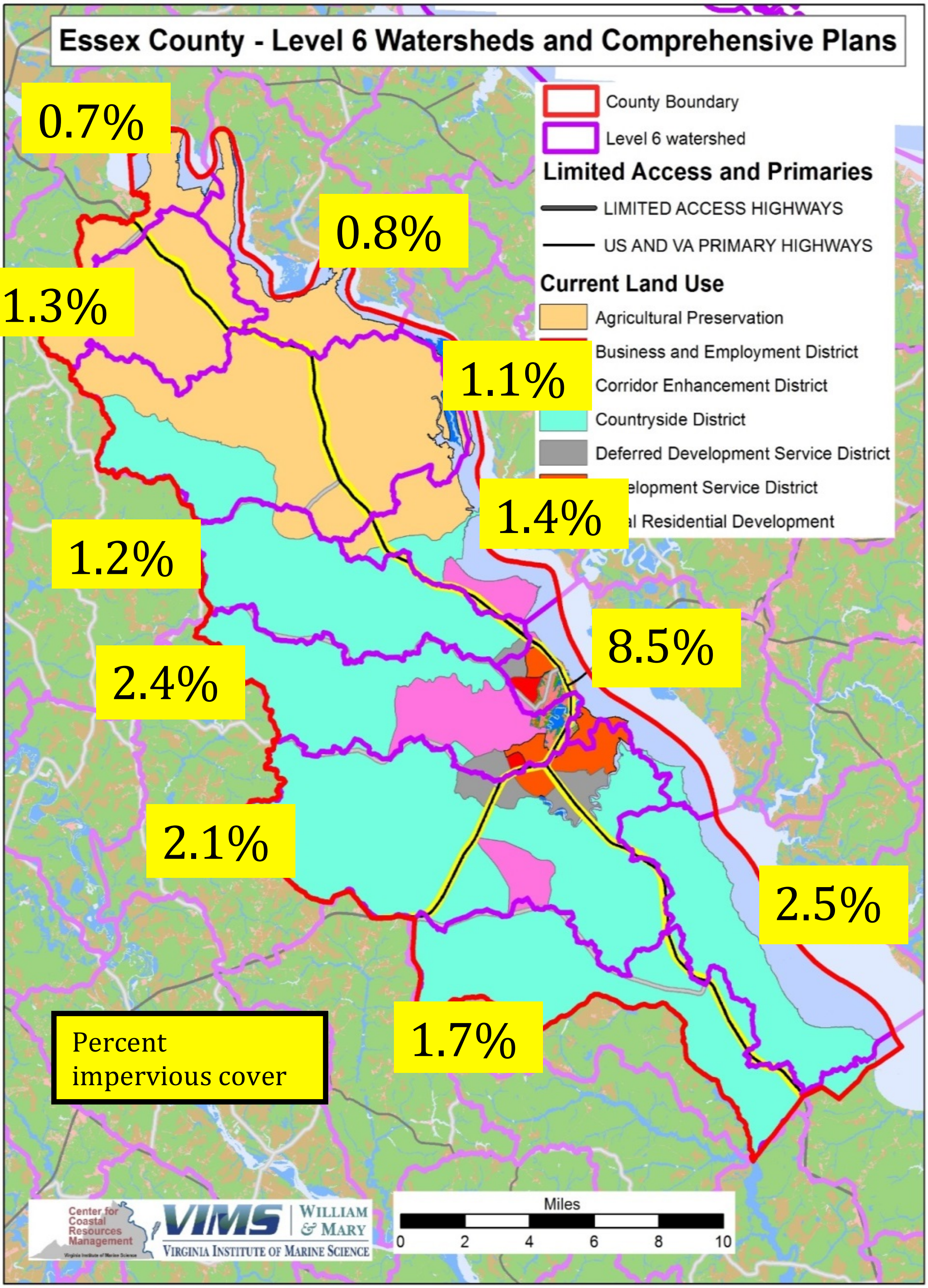


Schueler, T., Fraley-McNeal, L., and Capiella, K.
"Is Impervious Cover Still Important? Review of Recent Research"
Journal of Hydrologic Engineering, April 2009



Essex County - Level 6 Watersheds and Comprehensive Plans
County Boundary
Level 6 watershed
Limited Access and Primaries
LIMITED ACCESS HIGHWAYS
US AND VA PRIMARY HIGHWAYS
Current Land Use
Agricultural Preservation
Business and Employment District
Corridor Enhancement District
Countryside District
Deferred Development Service District
Development Service District
Rural Residential Development
Miles
0
2
4
6
8
10
Center for Coastal Resources Management
VIMS
William & Mary
Virginia Institute of Marine Science


Middlesex County - Level 6 Watersheds and Comprehensive Plans
County Boundary
Level 6 watershed
Limited Access and Primaries
LIMITED ACCESS HIGHWAYS
US AND VA PRIMARY HIGHWAYS
Future Lane Use
Agricultural Conservation
Commerical
Light Industrial
Mixed Use Res/Com
Nature Park
High Density Residential
Waterfront Commerical
1.4
1.5
3.0
4.3
1.8
4.5
2.7
7.9
4.2
Percent impervious cover
Center for Coastal Resources Management
VIMS
WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE
Miles
0
2
4
6
8
10


Essex County - Level 6 Watersheds and Comprehensive Plans
County Boundary
Level 6 watershed
Limited Access and Primaries
LIMITED ACCESS HIGHWAYS
US AND VA PRIMARY HIGHWAYS
Current Land Use
Agricultural Preservation
Business and Employment District
Corridor Enhancement District
Countryside District
Deferred Development Service District
elopment Service District
al Residential Development
0.7%
0.8%
1.3%
1.1%
1.4%
1.2%
8.5%
2.4%
2.1%
2.5%
1.7%
Percent impervious cover
Miles
0 2 4 6 8 10
Center for Coastal Resources Management
VIMS
William & Mary
Virginia Institute of Marine Science

Land cover classifications used in the most recent data available from the Virginia Geographic Information Network. Data and information available at:

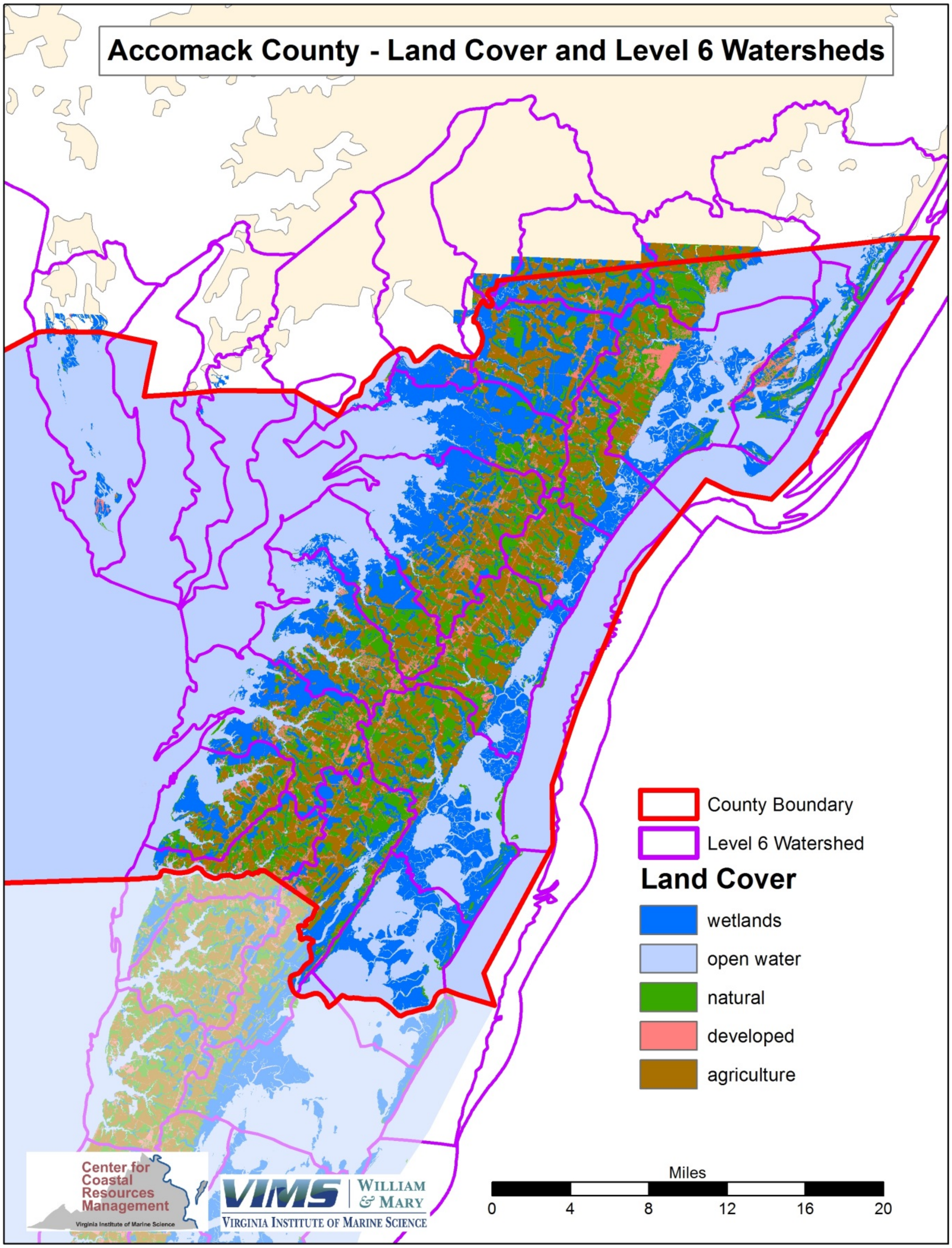
http://vgin.maps.arcgis.com/home/index.html

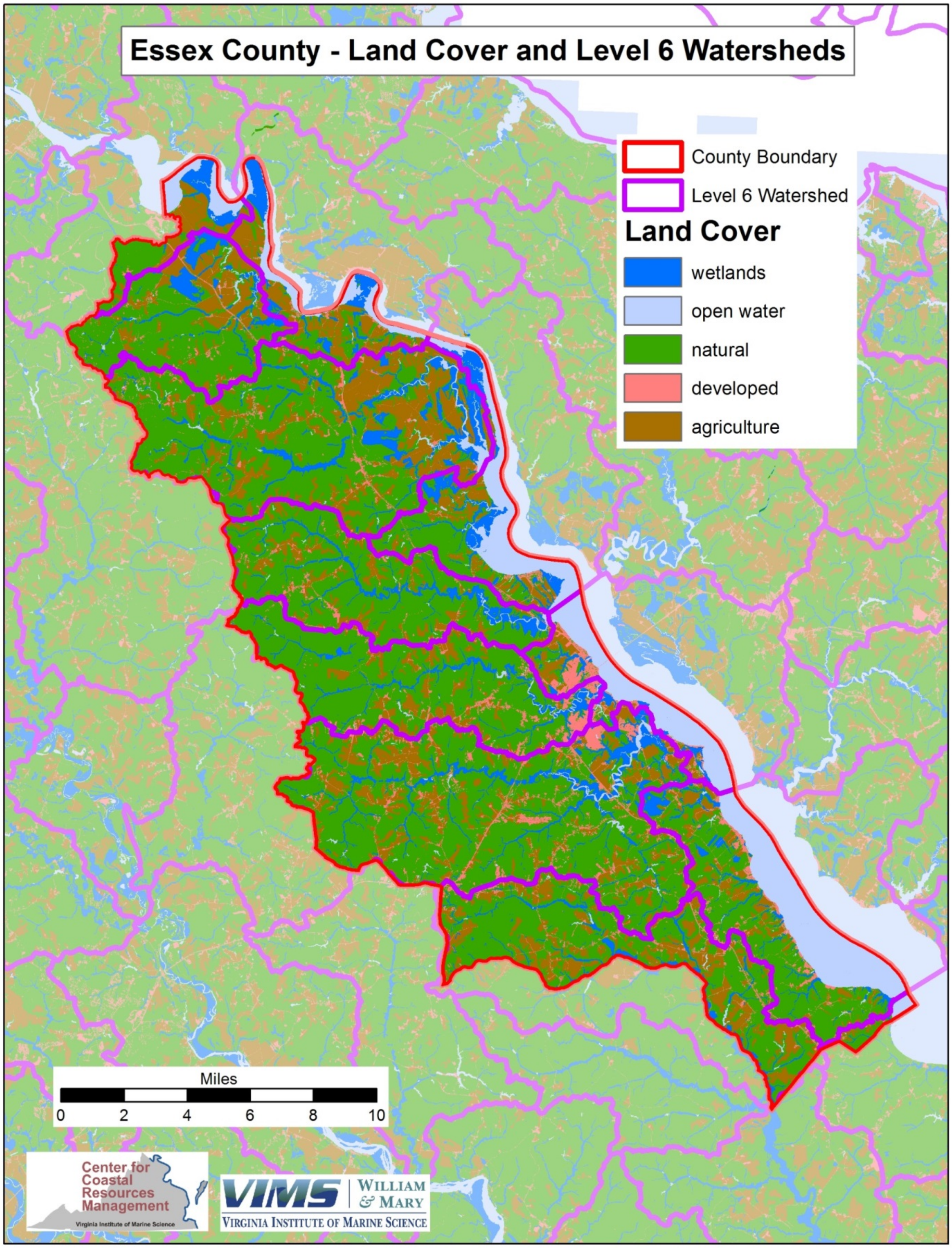
Classification Categories	Land Cover		Minimum Mapping Unit	Resolution	Accuracy
	Herbaceous	Turf Grass	Less than 2 acres with land use exceptions	1 Meter	85%
	Impervious	Extracted Buildings, driveways, parking lots, roads ,etc	Match resolution	1 Meter	95%
		External Local & Statewide Impervious data	Road centerline dependent	1 Meter	95%
	Forest	Forest	1 acre w/ min width restrictions	1 Meter	95%
		Tree	Less than 1 acre	1 Meter	85%
		Harvested/Disturbed Forest	1 acre w/ min width restrictions	1 Meter	85%
	Scrub/Shrub	Scrub/Shrub	1 acre w/ min width restrictions	1 Meter	85%
	Agriculture	Cropland	1 acre w/ min width restrictions	1 Meter	85%
		Pastureland	1 acre w/ min width restrictions	1 Meter	85%
	Wetlands	NWI/Other	As defined by NWI and TMI	1 Meter	85%
	Barren	Barren	Higher than the resolution	1 Meter	85%
	Water	Water	Higher than the resolution	1 Meter	95%

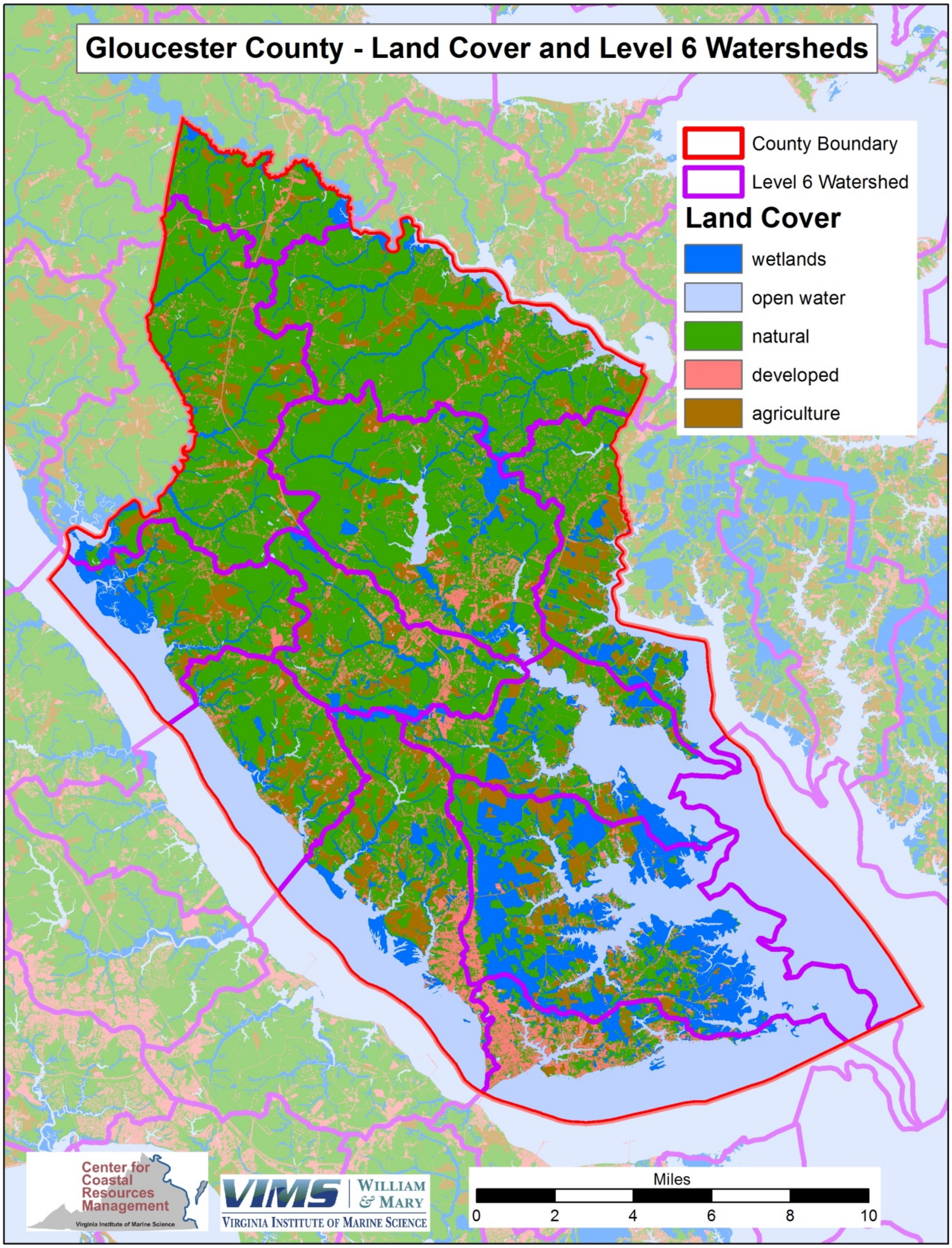
Table 1: Land Cover Classifications and Project Accuracy

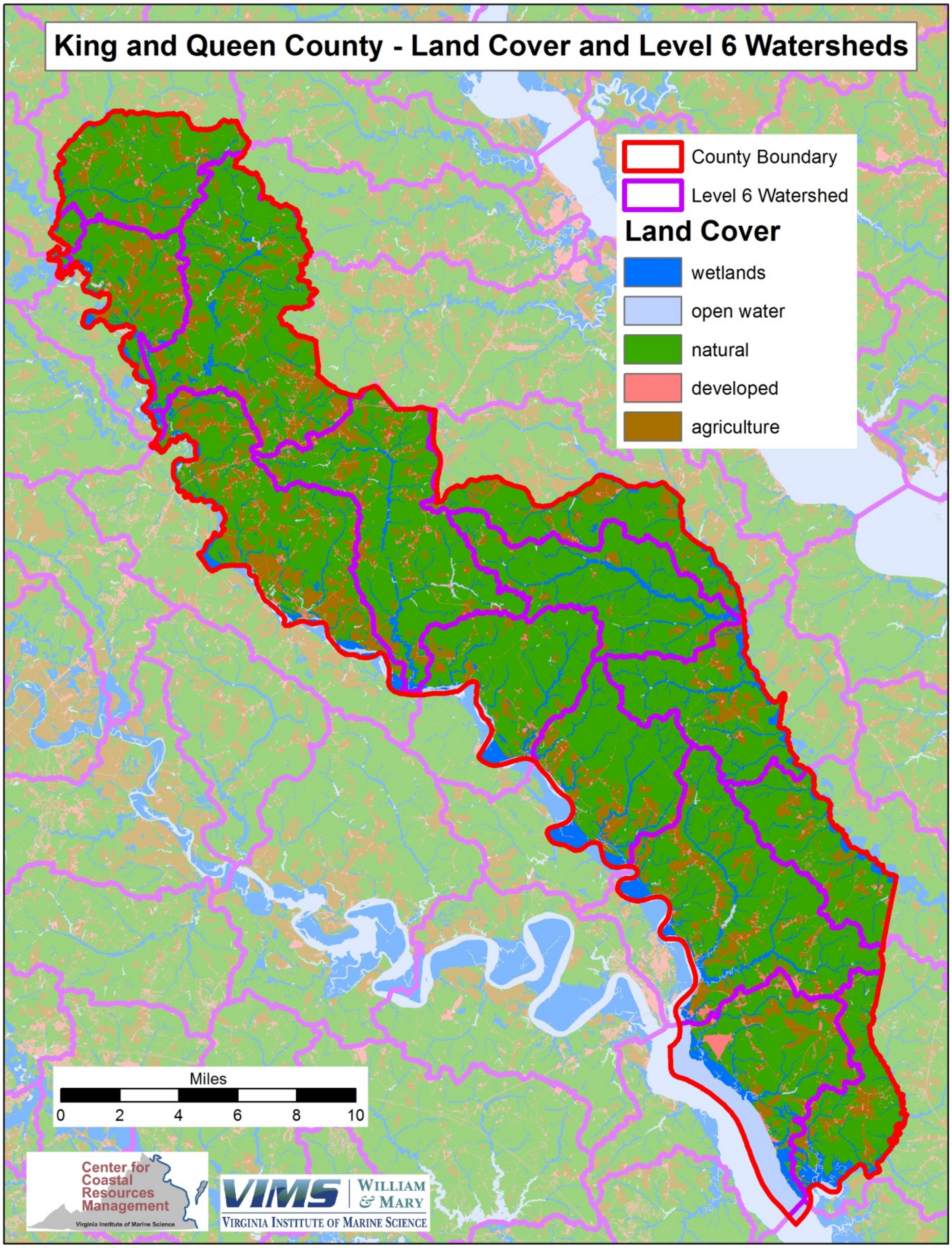
Background Research for Subcommittee 2: Landcover Information for Virginia Rural Coastal Localities

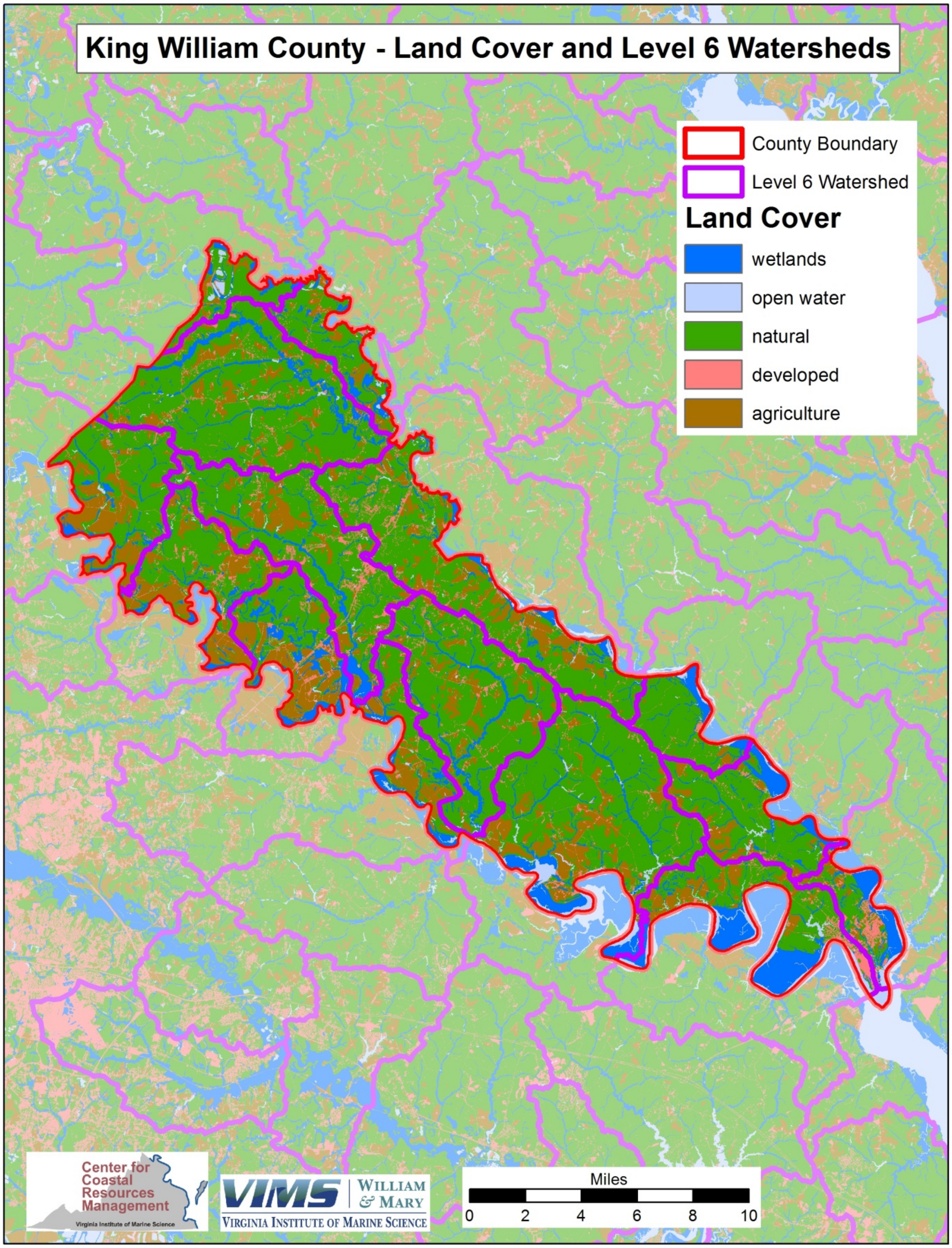
	land cover in acres		
county	natural	developed	agriculture
Accomack	68,744	68,622	124,326
Essex	101,971	10,405	35,264
Gloucester	85,359	14,452	15,140
King and Queen	145,041	7,930	31,259
King William	110,426	10,432	32,581
Lancaster	55,687	8,939	14,527
Mathews	24,031	6,749	5,389
Middlesex	53,717	8,067	15,450
Northampton	41,013	34,527	51,622
Northumberland	73,010	13,394	28,676
Richmond	76,266	7,737	26,135
Westmoreland	87,242	11,016	36,203

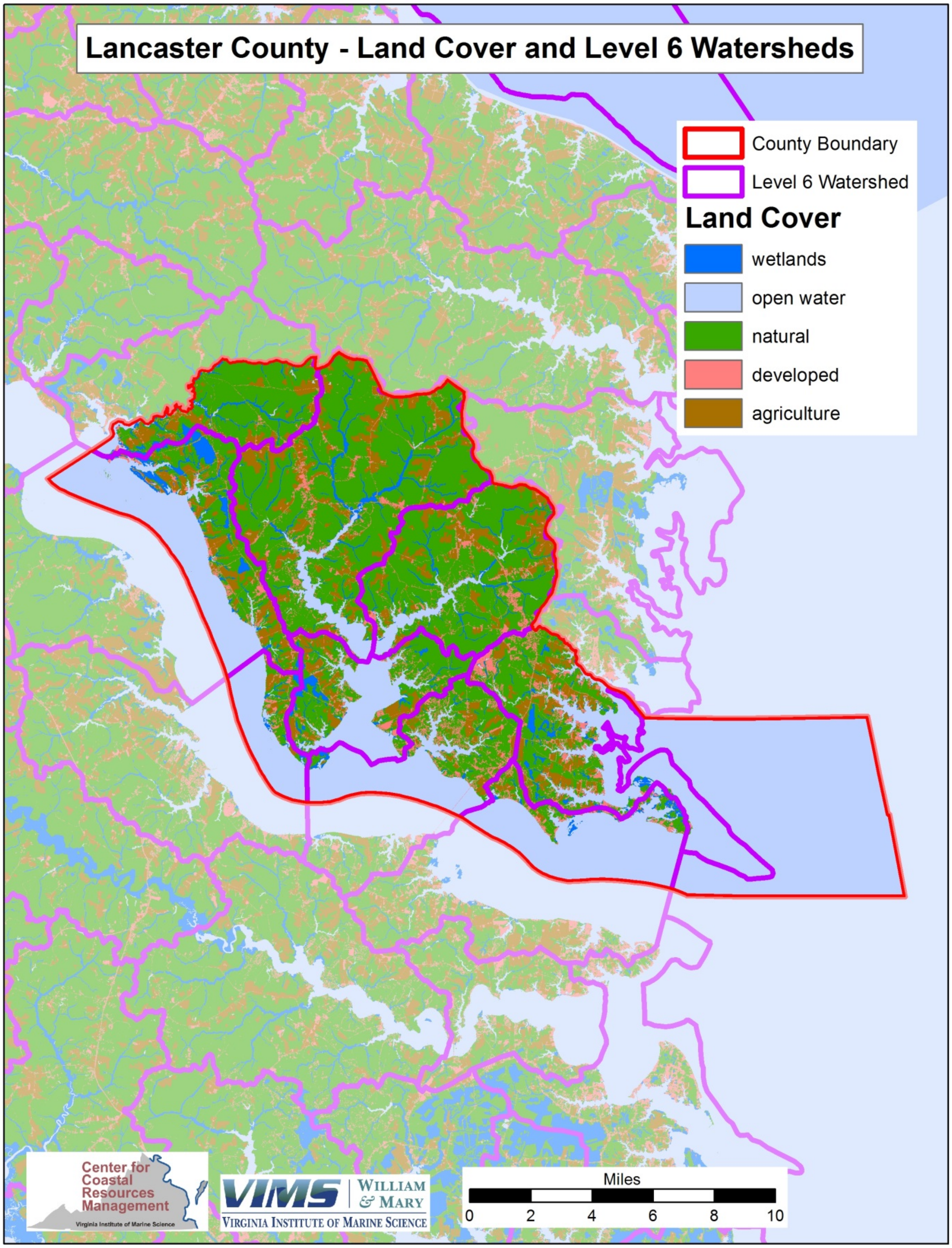

Accomack County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Miles
0 4 8 12 16 20
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science

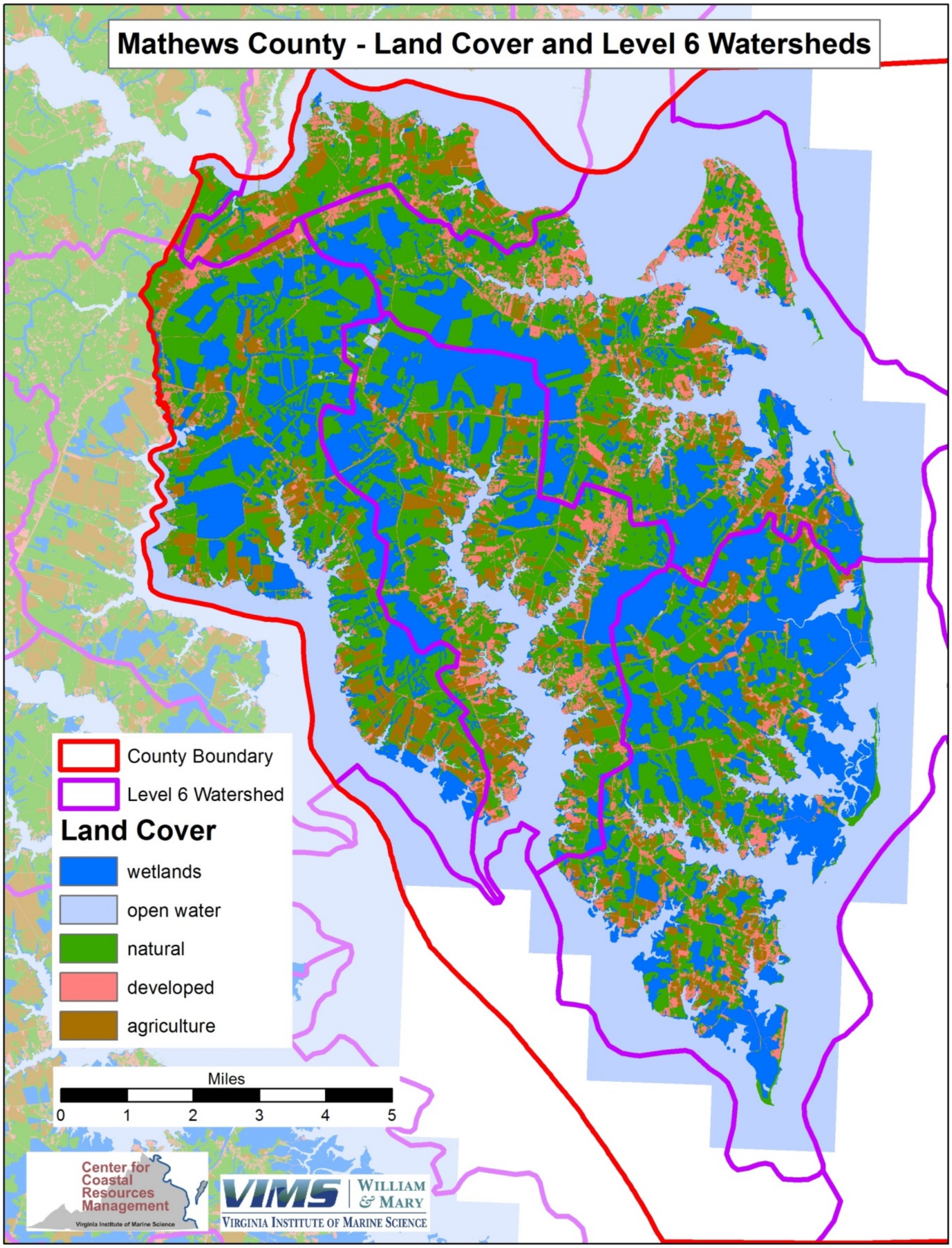

Essex County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Miles
0 2 4 6 8 10
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science

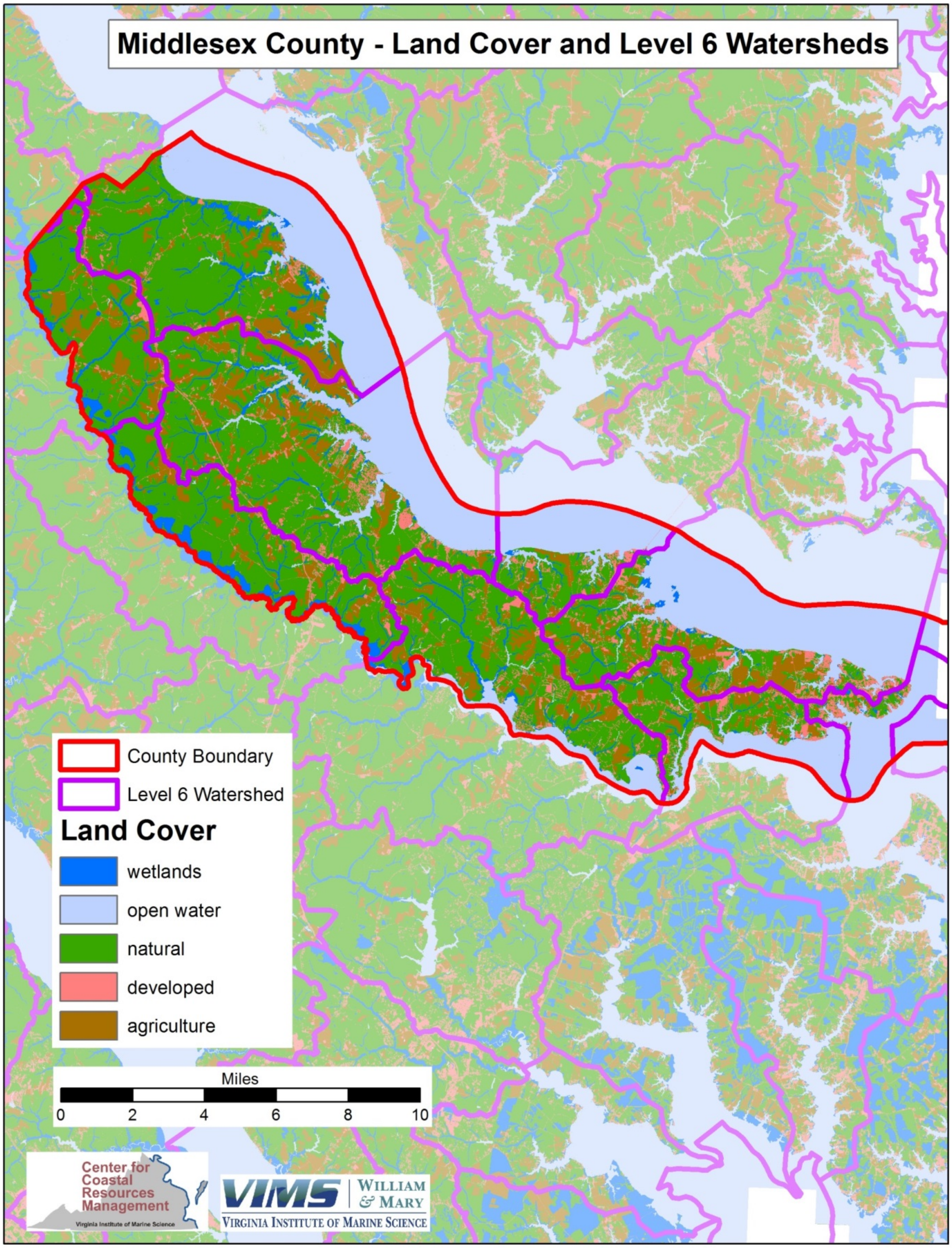

Gloucester County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science
Miles
0
2
4
6
8
10

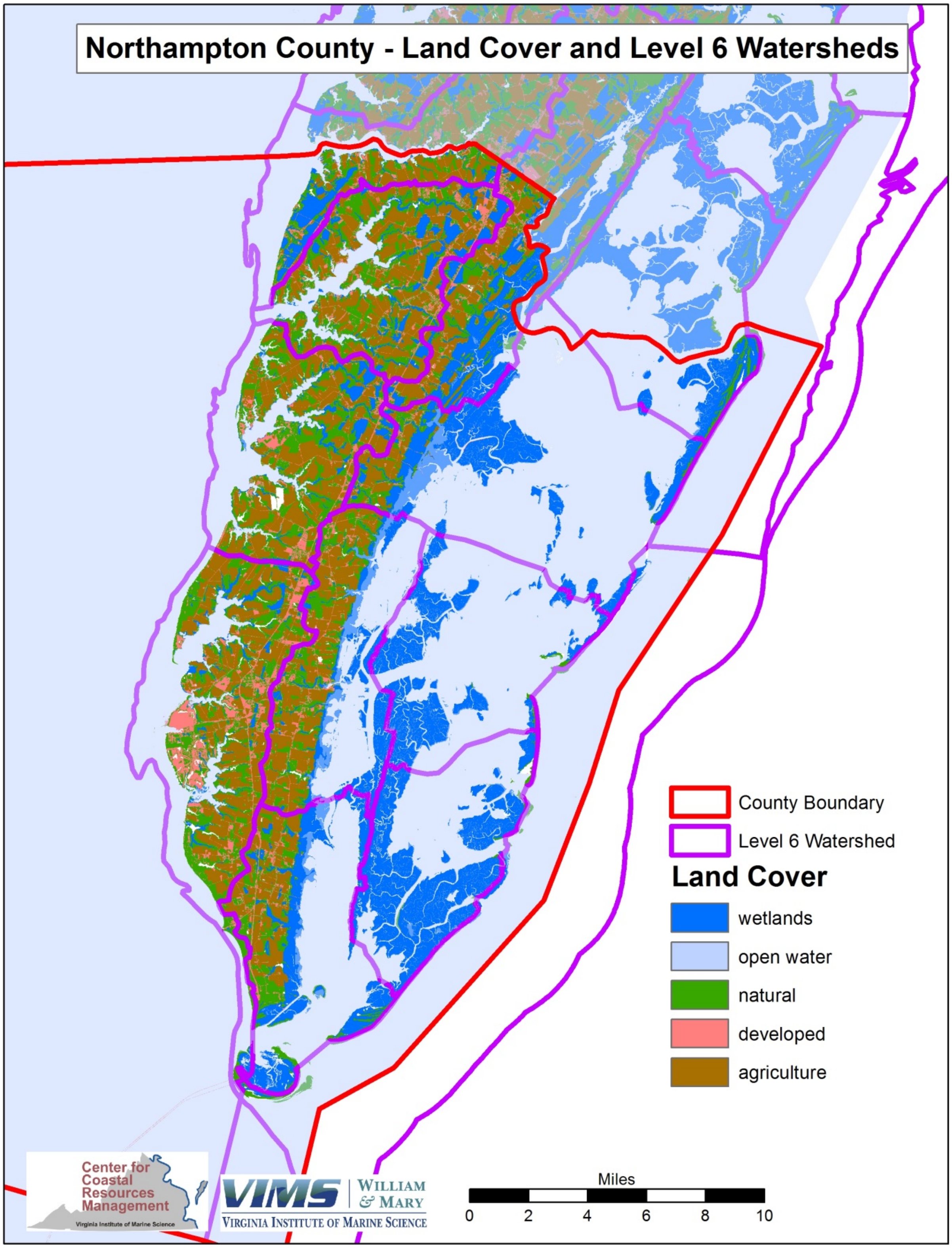

King and Queen County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Miles
0
2
4
6
8
10
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science

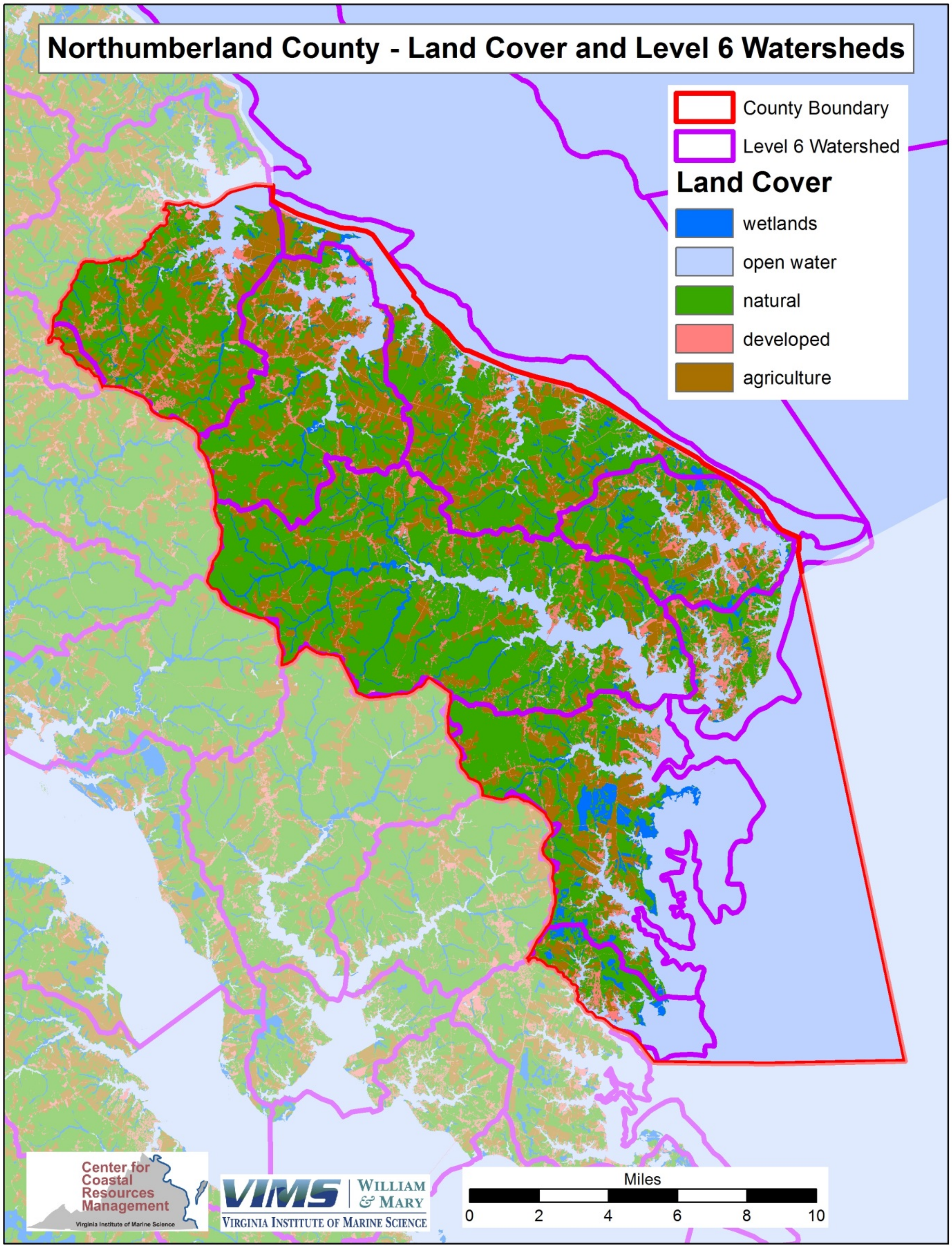

King William County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science
Miles
0 2 4 6 8 10

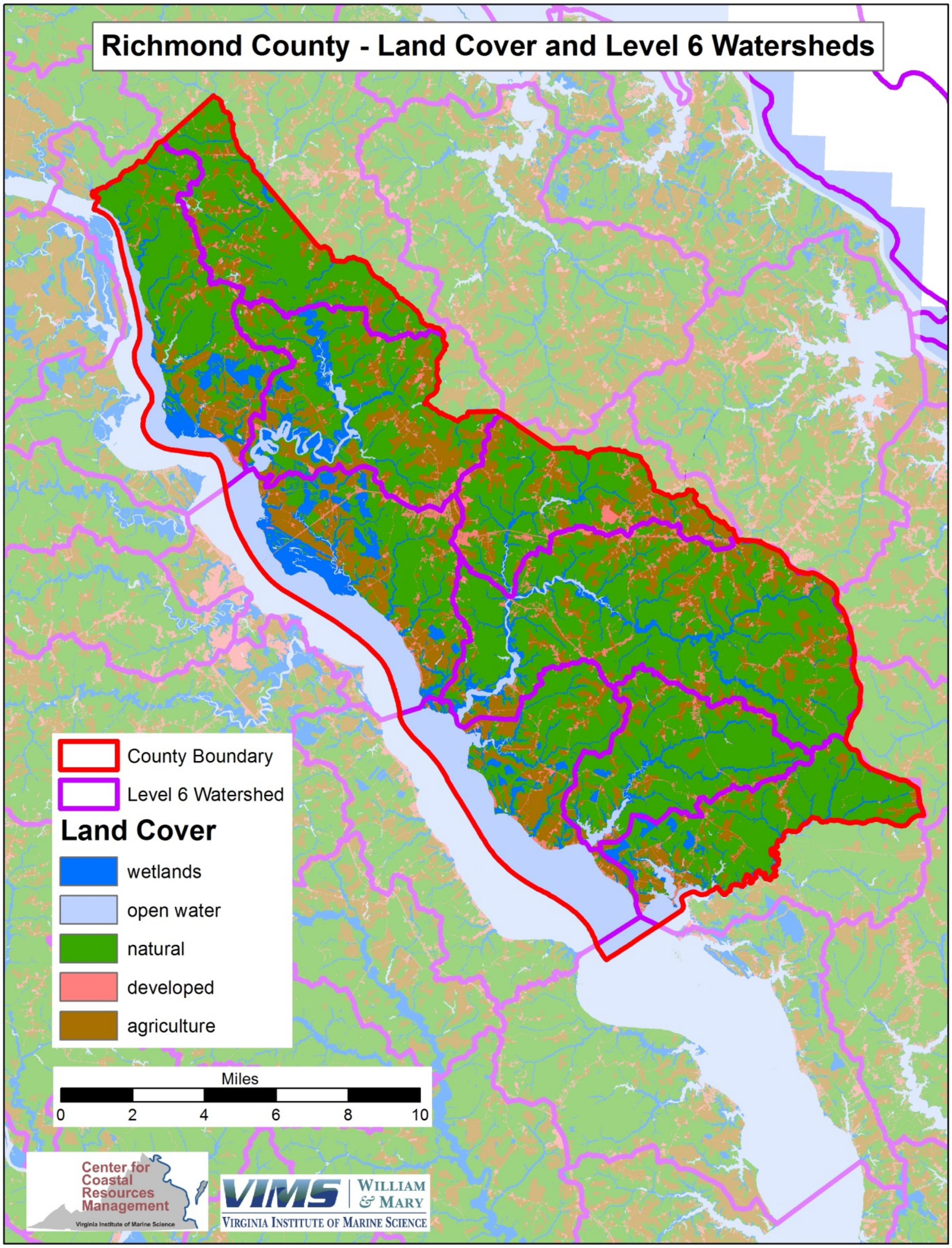

Lancaster County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science
Miles
0
2
4
6
8
10

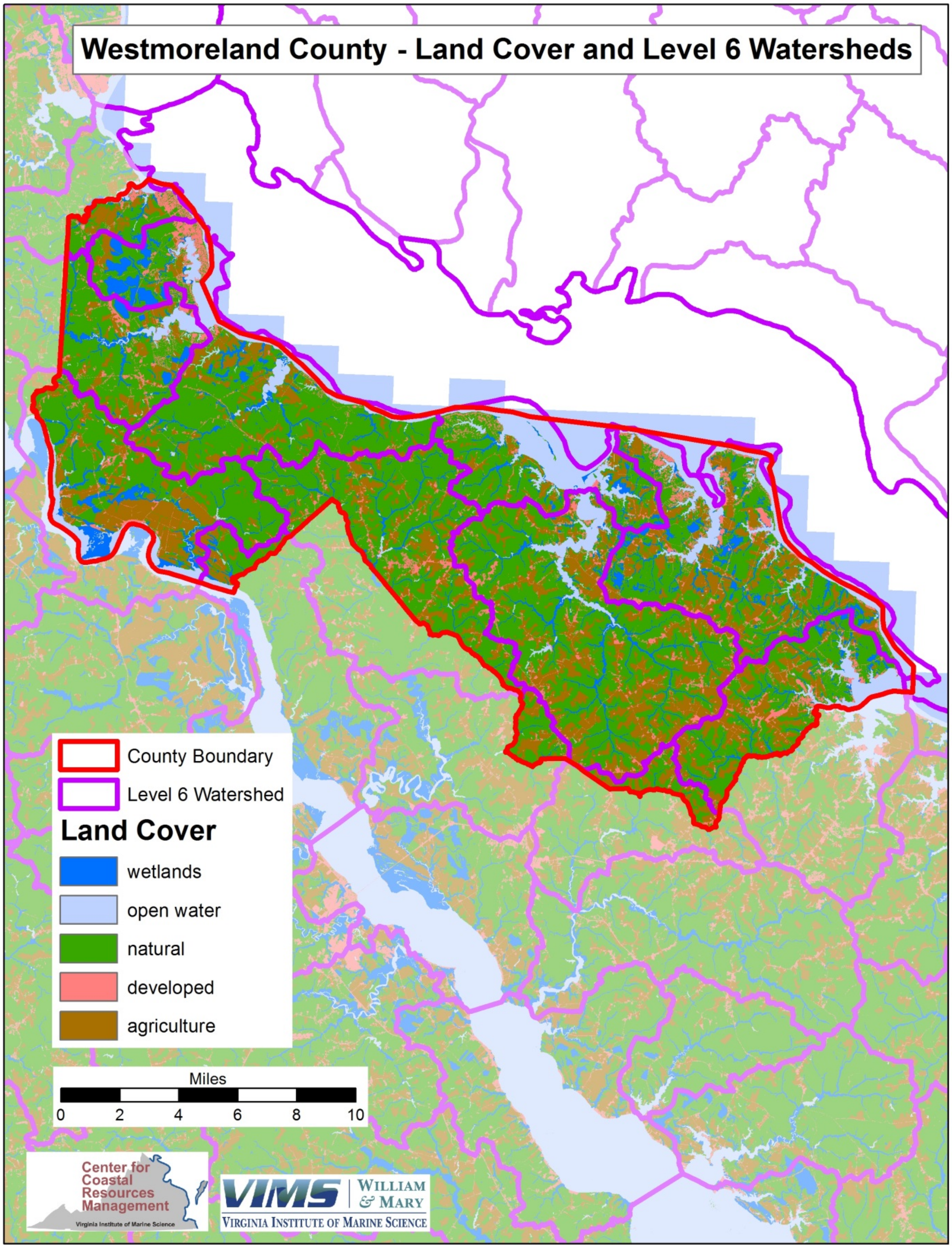

Mathews County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Miles
0
1
2
3
4
5
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science


Middlesex County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Miles
0
2
4
6
8
10
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science


Northampton County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science
Miles
0
2
4
6
8
10


Northumberland County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science
Miles
0
2
4
6
8
10


Richmond County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Miles
0
2
4
6
8
10
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science



Westmoreland County - Land Cover and Level 6 Watersheds
County Boundary
Level 6 Watershed
Land Cover
wetlands
open water
natural
developed
agriculture
Miles
0
2
4
6
8
10
Center for Coastal Resources Management
Virginia Institute of Marine Science
VIMS
William & Mary
Virginia Institute of Marine Science

Background Research for Subcommittee 2: Data on Northampton County Commercial Land Disturbance Between 2,500 Square Feet and 1 Acre

PLANNING, PERMITTING, AND ENFORCEMENT DEPARTMENT
NORTHAMPTON COUNTY, VIRGINIA

Susan McGhee, PE
Director
- *Planning*
- *Zoning*
- *Building*
- *Code Compliance*

16404 Courthouse Road

P.O. Box 538

Eastville, VA 23347

Phone: 757-678-0443 x541

Fax: 757-678-0483

Northampton County Commercial Land Disturbance
Between 2,500 square feet and 1 acre

2016

ESP-POD 2016-06	Town of Exmore (handled by Northampton County)
ESP-POD 2016-07	Northampton County
ESP –POD 2016-11	Willis Wharf (handled by Northampton County)
ESP-POD 2016-13	Northampton County

2015
None

2014

ESP-POD 2014-06	Northampton County

2013

ESP-POD 2013-01	Northampton County

2012

ESP-POD 2012-1	Town of Cheriton (handled by Northampton County)

Background Research for Subcommittee 2: Data on Middle Peninsula Commercial Land Disturbance Between 2,500 Square Feet and 1 Acre

Commercial Development 2500 sqft to 1 acre

Locality	Rural County	5 Year Total	MPO Area /Town	5 Year Total	2012	2013	2014	2015	2016
Gloucester	Yes	1	Yes	8	1	1	3	2	2
Mathews	Yes	5	na	na	1	2	0	0	2
Middlesex	Yes	11	na	na	1	2	1	4	3
Urbanna	na	na	Yes	0	0	0	0	0	0
Essex	Yes	11	na	na	4	2	1	2	2
Tapp	na	na	Yes	2	0	0	1	0	1
King and Queen	Yes	8	na	na	3	2	1	2	0
King William	Yes		na	na					
West Point	na	na	Yes	11	2	1	2	5	1
Grand Total		36		21	12	10	9	15	11

Locality	Rural County	5 Year Total	MPO Area /Town	5 Year Total	2012	2013	2014	2015	2016
Richmond County	Yes	2			0	0	2	0	0