A Scenario Analysis of the Potential Costs of Implementing the Phosphorus Management Tool on the Eastern Shore of Maryland

Prepared by:

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Executive Summary

Introduction

The Chesapeake Bay is a vast economic engine for a multi-state region supporting high property values, a vibrant seafood industry and fisheries sector, recreational boating and other tourism, among other economic activities. While the cleanup of the Bay is progressing, there are soils in some parts of Maryland that are saturated with Phosphorus. The Maryland Department of Agriculture (MDA) is proposing the use of a Phosphorus Management Tool (PMT) to better determine where these soils are and whether additional Phosphorus can be applied.

Agriculture is an economic activity sector representing over $8 Billion for the economy of the State of Maryland, supporting over 45,000 jobs. Many of the stakeholders from the agriculture sector are concerned that the rapid implementation of the PMT will create a significant economic burden that could put some of them out of business. Estimates of the potential costs associated with the proposed implementation of the PMT using three possible scenarios are presented in this public policy briefing document.

The Phosphorus Management Tool (PMT)

As explained in a 2013 University of Maryland Extension Bulletin, the PMT seeks to include new science relative to site and source factors and highlight management decisions more accurately targeted to reduce phosphorus losses from agricultural landscapes. The overall objective is to identify critical areas where there is a high P loss potential due to both a high transport potential and a large source of P, and also to encourage the use of management practices in those critical source areas that protect water quality.

The Project

The information gathering process, and the inputs from the MDA, EPA, and two stakeholder advisory panels, yielded over 4,500 pages of documents, reports, correspondence, opinions, and other source material that were used in designing this project. Since there was no historical or pilot study data available, a series of viable value ranges for each cost variable were created based on the input from the advisory panels and the review of the resource documents, reports, correspondence, opinions, and other source material. These ranges were adjusted to the specifics of each of the three scenarios provided and each scenario was converted into a simulation model based on two standalone (MACRO and MICRO) frameworks.

With the MACRO-Level framework, the broader costs impacts were examined. The variables examined included agriculture, land values, recreation, water-based commerce, as well as infrastructure costs, and community costs, among others. With the MICRO-Level framework, only farm level variables were examined. These include storage and transportation costs, synthetic fertilizer purchase costs, changes to land values, changes to production costs and associated revenues, etc. This MICRO-Level framework was used to develop a prototype PMT Regulation Implementation Analysis Dashboard Template for future use. Once a final PMT implementation scenario is determined by the Maryland Department of Agriculture, the template will be updated and a fully functional dashboard that reflects the actual scenario chosen will be activated.

The Three Scenarios

The three potential PMT implementation scenarios studied were provided by MDA. Cost and subsidy assumptions used in the scenario analysis were based on input provided by MDA, the advisory panels, and the information gleaned from the

documents and reports submitted by stakeholders. Additional input from the Environmental Protection Agency, Delmarva Poultry Industries, Inc., and other sources was also incorporated. The three scenarios examined are not forecasts. They simply represent the range of possible outcomes for each of the three different phase-in timelines under different subsidy assumptions.

Scenario 1 uses a two-year implementation schedule. In year 1 (2016), Nutrient Management Plans will be developed using both the existing PSI and the proposed PMT. Under this scenario, starting with Year 2 (2017), no P will be applied to lands with a PMT Risk Score of 100 or greater. To offset the cost of transportation for manure/poultry litter that will be required to be relocated and used in accordance with PMT; this scenario provides a total of $1,464,000 a year in subsidies for manure transportation and $1,465,000 a year in subsidies once implementation begins (Year 2) for Nutrient Management Plan Revisions reflecting current levels of program support.

Scenario 2 is a variant of Scenario 1 where the only difference is the replacement of the activities of Year 2 in Scenario 1 with a two-year phase-in. Under this scenario, more time is available for the development of the storage and transportation infrastructure, and some P application is still allowed in the first of the two years of phase-in. The annual subsidy amounts used for scenario 1 remain unchanged.

Scenario 3 uses a six-year implementation schedule. In addition, this scenario provides additional subsidies, incentives, and investments, including some capital expenditures for infrastructure development.

In Phase I of this scenario, the interim period between formal adoption of the new regulation and the commencement of implementation by farmers (February 2015 through November 2016), Nutrient Management Plans will be developed using both existing PSI and the proposed PMT. During this time, information on changes in management and volumes of acres/manure affected will be collected to further inform the development of MDA programmatic strategies. In Phase II, a multi-(5) year tiered implementation schedule will commence. Tiers and management requirements will be based on soil phosphorus levels (FIV) and agronomic crop need for P. These levels will be determined so that affected acres can be brought under the PMT regime incrementally in an effort to minimize disruption of markets related to manure. Tiers for PMT phase-in will be based on soil phosphorus levels (FIV), and may begin at some level above existing level of 150 FIV as determined by MDA. For example, in year one, the tier with the highest FIV level would begin a three-year transition to the PMT. In year two, the second tier begins, ending in year four. In year three, the lowest FIV tier (150 and greater) begins adoption and at the end of year five, all farms over FIV 150 will be managing in accordance with the PMT. P/manure applications allowed under resulting PMT risk categories (low/medium/high) will change during the respective transition periods, allowing more flexibility at first but ultimately result in no additional P being applied at the highest PMT risk category when each tier's implementation is complete.

This scenario also adds programmatic strategies for cost sharing, offsets, and other incentive based approaches, from existing and potential funding sources, to address economic impacts to affected farm operations, valued at about $39 Million between 2016 and 2021. The additional costs of the enhanced subsidies to the State over 6 years total $15.5 million for this scenario. Some of these costs are one time only or of limited duration and some are annual ongoing. These include tax incentives for manure/litter handling/transportation infrastructure, such as subtraction modification, and an Early Adopters Incentive to offset the costs of commercial fertilizer purchases for implementation in advance of prescribed schedule. These incentives will be offered for a defined and limited time in the early stages of the five-year implementation timetable.

In addition there is approximately $40 Million in existing programs available over the same time horizon for alternative use technologies, providing alternative applications for manure/poultry litter. These new uses would include manure to

energy alternatives, as well as alternative uses to land application. According to the MDA, certain projects under discussion have the potential to utilize from 125,000 to 250,000 tons of litter, beginning in the 2016/2017 horizon. As some of these alternative uses become a reality, the PMT implementation costs are expected to decline. Since most of these alternative uses are not currently available, the potential cost reductions attributable to them are not incorporated into the current version of Scenario 3.

Finally, the extended phase-in schedule (six-years) envisaged in Scenario 3 would allow for programmatic adjustments based on new data as implementation progresses. This time-frame also would allow for any other systemic changes to be taken into account so that implementation variables can be adjusted if necessary. Since there is currently no data or data estimates for such future events, their impacts have not been incorporated into the current version of Scenario 3.

Potential Costs of PMT Implementation

All three scenarios utilized 228,000 tons of chicken litter as the amount to be transported. The average transportation distance was assumed to be 50 miles and the average transportation cost (comprising loading, transporting, unloading costs and the value of the litter) was assumed to be $28 per ton. The "Other Costs" variable included average cost of replacement for one ton of chicken litter with inorganic fertilizers at around $60 to $75 dollars. This figure can be as high as $90 for the farmers who cannot apply any litter to their farms. The average amount is a result of discounting to account for farms that would receive litter for free and farmers with varying soils. The yield differentials between organic and inorganic fertilizer and different types of crops were also incorporated in this calculation. The different cost structures of "No-Land" farms (such as added house cleanout costs) were also incorporated into these "Other Cost" calculations (as well as to the subsidy assumptions in Scenario 3). These assumptions were based on information provided by advisory panel members, the MDA, and the resource documents reviewed.

To be able to compare the three scenarios, the simulation findings for Scenarios 1 and 2 were extrapolated over the same six-year horizon of Scenario 3. Based on the simulation results, Scenario 3 has the lowest "Six-Year Subsidized Cost" (farmers' implementation costs minus subsidies) estimate with a mean value of $22.5 Million ($1.8 Million Standard Deviation) versus a mean value of $30 Million ($0.7 Million Standard Deviation) for Scenario 2, and a mean value of $51.6 Million ($1.4 Million Standard Deviation) for Scenario 1.

The Cost of Other Sectors Meeting the TDML Goals

The cost of meeting the Chesapeake Clean Water Blueprint goals through actions involving sectors other than agriculture was also examined. A communiqué from the Chesapeake Bay Commission states that "Maryland must reduce phosphorus by 589,000 lbs. (as of 2010) and must maintain that reduction even with added growth in development and wastewater." While these costs are important policy considerations, unless some of the projected savings from not incurring them are applied directly to the mitigation of the costs of implementing the PMT, it is not appropriate to incorporate them into the three Scenarios analyzed in this analysis.

Benefits of PMT Implementation

As discussed earlier, the MACRO Framework was utilized to estimate the costs and benefits of implementing the PMT to the resident of Maryland. There is ample evidence in the literature proving the economic value of clean water, and in particular, the economic benefits of meeting the Chesapeake Clean Water Blueprint goals for the entire Bay Watershed. Some of the most detailed and well defined estimates of these benefits can be found in an October 2014 Chesapeake Bay Foundation (CBF) report entitled *The Economic Benefits of Cleaning Up the Chesapeake*. According to this report, implementing the Blueprint will lead to $22 Billion in added annual economic value throughout the watershed. These values are derived from the enhanced natural benefits which include air and water filtering, recreation, seafood and farming production, aesthetics (including enhanced property values), clean drinking water, flood control, and pollution

reduction. While the CBF study concentrates primarily on benefits, its authors estimate that the medium-term costs of implementation are likely to be around $5 Billion annually. Further, they estimate that, if the Blueprint is not fully implemented, pollution loads will increase and the value of the natural benefits will decline by $5.6 billion annually throughout the watershed.

The Maryland portion of the value of meeting the Blueprint goals ($4.6 Billion annually) is well documented in the CBF study. Unfortunately, it is difficult to isolate the portion of those benefits that can be directly attributed to the PMT implementation on the Eastern Shore of Maryland. Based on a series of assumptions provided by advisory panel members and a review of the available resources, and using the annual value figures from the CBF study, these annual statewide benefits of PMT implementation on the Eastern Shore were estimated to be about $100 Million after full implementation is achieved. In addition to the natural benefit categories described in the CBF study, this $100 Million estimate includes Maryland based economic activity that could be triggered by spending related to PMT implementation (Please refer to Figures 1 and 2).

While significant, this statewide MACRO-Level benefit estimate attributable to the implementation of the PMT on the Eastern Shore cannot be directly compared to the farm-level costs of implementation estimated in the three scenarios. Most of the MACRO-Level benefit estimates involve value enhancements and potential cost savings. They are not financial resources that can be used to defray the farmers' PMT implementation costs. Some stakeholders believe that, given the greater uncertainty of the future benefit estimations, they should be discounted relative to the more predictable farm level costs.

The Prototype of a MICRO-Level Dashboard Template

A prototype PMT implementation dashboard template was developed. This template can be used in the future to estimate PMT implementation impacts at the farm-level.

Study Limitations

Since the actual scenario of PMT Implementation has not yet been determined, the potential PMT implementation cost estimates calculated for this public policy briefing document was based on three specific likely scenarios provided by the Maryland Department Agriculture. There is no guarantee that any one of these scenarios will actually be the final chosen scenario. In addition, there are a large number of unknowns and uncertainties with each of the three given scenarios, making the estimates subject to significant variations.

There were different opinions and assumptions as well as a lack of trust among some of the stakeholders providing input for the study. To accommodate these different assumptions, wider than ideal ranges of probable values for each of the three scenario data nodes were used.

The three scenarios used in this study, by design, do not address other systemic issues where different stakeholders have differing opinions. The scenarios simply compare the estimated implementation costs versus the available subsidies for each scenario, independent of these differing systemic assumptions, and for a specific geography—the eastern Shore of Maryland. While it is important to address these differences in opinion at the public policy level, they remain outside the scope of this project.

The greatest limitation involves the scenario assumptions that pertain to estimating the incremental benefits of PMT implementation at the MACRO-Level. With all the uncertainties and unknowns previously discussed, determining the viable cost ranges of the PMT implementation that will be borne by farmers on the Eastern Shore is difficult enough.

Determining the portion of the overall economic value of a clean Chesapeake Bay that can be attributed to PMT implementation is significantly more difficult.

Recent reports suggest that the Bay is on target with regards to some of the Bay Blueprint goals. The October 2014 CBF report, for the first time, quantifies the benefits of reaching the Chesapeake Clean Water Blueprint goals, as well as the costs of not reaching them, taking a very large number of factors into account, covering the entire Bay watershed. Unfortunately, neither the CBF study nor the other studies reviewed for this study shed any light on how one would isolate the benefit of reducing one of the various pollution factors in a very small portion of the total watershed. So the question is how and when would property values, commercial fishing, recreational use, etc. increase in a predictable way if 228,000 tons of manure is removed from the nine counties of the Eastern Shore over the next six years?

It can be assumed that, at a minimum, the removal of the extra P will help maintain the overall economic value of the Bay. But, estimating the incremental improvements to this value attributable to various reduction levels of Phosphorus levels cannot be easily estimated? Some simple assumptions were used in this project to estimate such incremental values but these assumptions cannot be fully validated without further data based on actual implementation outcomes. As a result, this question remains insufficiently answered. Once MDA determines a final implementation scenario, and a few years' worth of data is available, this question should be revisited.

Finally, in a watershed that spans many states, the PMT will apply only to Maryland. Even though the other states in the watershed will still be responsible for the total amount of P that will reach the Chesapeake Bay, some stakeholders believe the farmers there will not be subjected to the level of scrutiny that Maryland farmers will face. The Maryland farmers are concerned about the competitive disadvantage this will cause them in a regional commodity market environment. Since the extent of such production migration and the magnitude of the associated harm are difficult to predict at this point in time, the simulation models for the three scenarios used in this analysis do not include the potential impacts of such economic disadvantages.

Future Economic Data Collection Protocols for PMT Implementation

This project was designed to yield a public policy briefing document. It was not meant to serve as a comprehensive economic impact study. The lack of actual implementation data and the wide variations in the assumptions of the different stakeholders about the costs (and benefits) of PMT implementation are serious limitations not only to this current endeavor, but to a future, more comprehensive economic impact study as well. If, as the PMT is implemented, well designed data collection protocols are established, data on actual implementation costs can be compiled. With three to five years of actual implementation cost data, a panel of agriculture and environmental economists would be able to conduct a comprehensive economic impact study. Such a comprehensive economic impact study would be far superior to the scenario analysis (with wide ranges of estimated values) used in this document. Such a study, using an IMPLAN (IMpact analysis for PLANning) economic impact model, would be able to measure both direct and secondary impacts of PMT implementation over time. Another benefit of such a study would be the incorporation of findings from current and future research on the costs of further reducing P deliveries to the Bay by other means (e.g. buffers, reduced tillage, etc.). It is also assumed that the potential impact of new technologies, the calibration of the PMT, and other uncertainties will be better known with a few years of actual implementation. These changing variables might change the cost of PMT implementation by reducing the amount of litter that would have to be transported away from the farms impacted. Lastly, such a future study could include the costs and benefits of innovation with a higher degree of accuracy. The effects of such future innovations are difficult to predict. But, once there is actual data from farmers and other entrepreneurs who might develop other ways to use litter, estimating the PMT implementation cost impacts of their innovations would become easier.

A Scenario Analysis of the Potential Costs of Implementing the Phosphorus Management Tool on the Eastern Shore of Maryland

Introduction

The Chesapeake Bay is a vast economic engine for a multi-state region supporting high property values, a vibrant seafood industry and fisheries sector, recreational boating and other tourism, among other economic activities. An important part of these economic benefits accrue to the State of Maryland. While the cleanup of the Bay is progressing, there are soils in some parts of Maryland that are saturated with Phosphorus. The Maryland Department of Agriculture (MDA) is proposing the use of a Phosphorus Management Tool (PMT) to better determine where these soils are and whether additional Phosphorus can be applied to such soils.

Agriculture is an economic activity sector representing over $8 Billion for the economy of the State of Maryland, supporting over 45,000 jobs. Many of the stakeholders from the agriculture sector are concerned that the rapid implementation of the PMT will create a significant economic burden that could put some of them out of business. Based on these concerns, and to implement requirements from the Maryland General Assembly, the MDA contracted with the Business, Economic, and Community Outreach Network (BEACON) of the Franklin P. Perdue School of Business at Salisbury University to estimate the potential costs associated with the proposed implementation of the PMT using three possible scenarios.

The Phosphorus Management Tool (PMT)

As explained in a 2013 University of Maryland Extension Bulletin, the objective of the PMT is to update a phosphorus site index (PSI) that uses readily available information to evaluate the relative risk of phosphorus (P) transport from agricultural fields where P may be applied either as inorganic or organic fertilizer. The PMT seeks to include new science relative to site and source factors and highlight management decisions more accurately targeted to reduce phosphorus losses from agricultural landscapes. The overall objective is to identify critical areas where there is a high P loss potential due to both a high transport potential and a large source

of P, and also to encourage the use of management practices in those critical source areas that protect water quality. (Sources: MDA and McGrath, Coale, Fiorellino, 2013).

The Project

With input from MDA and a number of community-based organizations, a group of over 70 stakeholders representing the agricultural, environmental, public policy, and other related sectors was assembled. This group provided input regarding expected outcomes and consequences of PMT implementation. In addition, two smaller advisory panels were assembled to focus on the MACRO and MICRO-level analyses.

The information gathering process and the panel inputs yielded over 4,500 pages of documents, reports, correspondence, opinions, and other source material, most of which was contributed by panel members. It should be noted that these documents were not meant to serve as an exhaustive literature review. They were used solely to inform the design of the scenario models. A bibliography of these resource documents can be found at the end of this report. Due to the many unknowns associated with the proposed PMT regulations, some of these documents contained information or conclusions that were somewhat contradictory. The problems and subsequent limitations associated with these contradictions are discussed in the "Limitations" section of this report.

Since there was no historical or pilot study data available, a series of viable value ranges for each cost variable were created based on the input from the advisory panels and the review of the resource documents, reports, correspondence, opinions, and other source material. These ranges were adjusted to the specifics of each of the three scenarios provided and each scenario was converted into a simulation model based on two standalone (MACRO and MICRO) frameworks.

With the MACRO-Level framework, the broader costs impacts were examined. The variables examined included agriculture, land values, recreation, water-based commerce, as well as

infrastructure costs, and community costs, among others. The components of the MACRO-Level Framework are presented in Figure 1 below.

Figure 1: Components of the MACRO-Level Framework

MARYLAND BENEFITS	MARYLAND COSTS
• Inorganic Versus Litter in Receiving Areas • P Reduction • Innovation Benefits • Sectorial Benefits (Seafood, Recreation, etc.) • Land Values • Alternative Technologies • Blueprint Compliance Cost Savings	• Infrastructure Cost Subsidies • Transportation Cost Subsidies • Incentives • Alternative Technology Investments
EASTERN SHORE BENEFITS	**EASTERN SHORE COSTS**
• Reduced Cost of Inorganic Fertilizer for Some • Free Organic Fertilizer for Some • P Reduction • Alternative Uses for Litter	• Community Impacts • Infrastructure Costs • Transportation Costs • Inorganic Fertilizer Costs • Yield Changes • Land Values • Employment Impacts • Noise Pollution • Emissions and Air Pollution • Traffic

With the MICRO-Level framework, only farm level variables were examined. These include storage and transportation costs, synthetic fertilizer purchase costs, changes to land values, changes to production costs and associated revenues, etc. This MICRO-Level framework was used to develop a prototype PMT Regulation Implementation Analysis Dashboard Template for future use. Once a final PMT implementation scenario is determined by the Maryland Department of Agriculture, the template will be updated and a fully functional dashboard that

reflects the actual scenario chosen will be activated. The components of the MICRO-Level Framework are presented in Figure 2 below.

Figure 2: Components of the MICRO-Level Framework

HIGH P FARMS	LOW P FARMS
• Storage Costs • Transportation Costs • Cost of Infrastructure • Added Cost of Inorganic Fertilizer • Yield Changes (Animal, Grain, Other) • Change in Margins • Change in Market Share • Change to Land Value • Compliance Costs • Miscellaneous Costs	• Changes to Land Value • Reduced Cost of Inorganic Fertilizer • Free Organic Fertilizer • Yield Changes (Animal, Grain, Other)

The Three Scenarios

The three potential PMT implementation scenarios studied were provided by MDA. The cost and subsidy assumptions used in the three scenarios were based on input provided by MDA, the information provided by the two advisory panels, and information gleaned from the documents and reports submitted by stakeholders. Additional input from the Environmental Protection Agency, Delmarva Poultry Industries, Inc., and other sources was also incorporated. The three scenarios examined are not forecasts. They simply represent the range of possible outcomes for each of the three different phase-in timelines under different subsidy assumptions. The influence diagrams of the three scenarios are presented in Appendix A and the descriptions of the data node labels used in all three scenarios can be found in Appendix B.

Scenario 1 uses a two-year implementation schedule. In year 1 (2016), Nutrient Management Plans will be developed using both the existing PSI and the proposed PMT. Under this scenario, starting with Year 2 (2017), no P will be applied to lands with a PMT Risk Score of 100 or greater. To offset the cost of transportation for manure/poultry litter that will be required to be relocated and used in accordance with PMT; this scenario provides a total of $1,464,000 a year in subsidies for manure transportation and $1,465,000 a year in subsidies once implementation begins (Year 2) for Nutrient Management Plan Revisions reflecting current levels of program support.

Scenario 2 is a variant of Scenario 1 where the only difference is the replacement of the activities of Year 2 in Scenario 1 with a two-year phase-in. Under this scenario, more time is available for the development of the storage and transportation infrastructure, and some P application is still allowed in the first of the two years of phase-in. The annual subsidy amounts used for scenario 1 remain unchanged.

Scenario 3 uses a six-year implementation schedule. In addition, this scenario provides additional subsidies, incentives, and investments, including some capital expenditures for infrastructure development.

In Phase I of this scenario, the interim period between formal adoption of the new regulation and the commencement of implementation by farmers (February 2015 through November 2016), Nutrient Management Plans will be developed using both existing PSI and the proposed PMT. During this time, information on changes in management and volumes of acres/manure affected will be collected to further inform the development of MDA programmatic strategies. In Phase II, a multi-(5) year tiered implementation schedule will commence. Tiers and management requirements will be based on soil phosphorus levels (FIV) and agronomic crop need for P. These levels will be determined so that affected acres can be brought under the PMT regime incrementally in an effort to minimize disruption of markets related to manure. Tiers for PMT phase-in will be based on soil phosphorus levels (FIV), and may begin at some

level above existing level of 150 FIV as determined by MDA. For example, in year one, the tier with the highest FIV level would begin a three-year transition to the PMT. In year two, the second tier begins, ending in year four. In year three, the lowest FIV tier (150 and greater) begins adoption and at the end of year five, all farms over FIV 150 will be managing in accordance with the PMT. P/manure applications allowed under resulting PMT risk categories (low/medium/high) will change during the respective transition periods, allowing more flexibility at first but ultimately result in no additional P being applied at the highest PMT risk category when each tier's implementation is complete.

This scenario also adds programmatic strategies for cost sharing, offsets, and other incentive based approaches, from existing and potential funding sources, to address economic impacts to affected farm operations, valued at about $39 Million between 2016 and 2021. The additional costs of the enhanced subsidies to the State over 6 years total $15.5 million for this scenario. Some of these costs are one time only or of limited duration and some are annual ongoing. These include tax incentives for manure/litter handling/transportation infrastructure, such as subtraction modification, and an Early Adopters Incentive to offset the costs of commercial fertilizer purchases for implementation in advance of prescribed schedule. These incentives will be offered for a defined and limited time in the early stages of the five-year implementation timetable.

In addition there is approximately $40 Million in existing programs available over the same time horizon for alternative use technologies, providing alternative applications for manure/poultry litter. These new uses would include manure to energy alternatives, as well as alternative uses to land application. According to the MDA, certain projects under discussion have the potential to utilize from 125,000 to 250,000 tons of litter, beginning in the 2016/2017 horizon. As some of these alternative uses become a reality, the PMT implementation costs are expected to decline. Since most of these alternative uses are not currently available, the potential cost reductions attributable to them are not incorporated into the current version of Scenario 3.

Finally, the extended phase-in schedule (six-years) envisaged in Scenario 3 would allow for programmatic adjustments based on new data as implementation progresses. This time-frame also would allow for any other systemic changes to be taken into account so that implementation variables can be adjusted if necessary. Since there is currently no data or data estimates for such future events, their impacts have not been incorporated into the current version of Scenario 3.

MDA estimates for these programmatic strategies for cost sharing, offsets, other incentive-based approaches, and alternative use technologies are presented in Appendix C. The Assumptions behind these estimates can be found in Appendix D.

Potential Costs of PMT Implementation

All three scenarios utilized 228,000 tons of chicken litter as the amount to be transported. The average transportation distance was assumed to be 50 miles and the average transportation cost (comprising loading, transporting, unloading costs and the value of the litter) was assumed to be $28 per ton. The "Other Costs" variable included average cost of replacement for one ton of chicken litter with inorganic fertilizers at around $60 to $75 dollars. This figure can be as high as $90 for the farmers who cannot apply any litter to their farms. The average amount is a result of discounting to account for farms that would receive litter for free and farmers with varying soils. The yield differentials between organic and inorganic fertilizer and different types of crops were also incorporated in this calculation. The different cost structures of "No-Land" farms (such as added house cleanout costs) were also incorporated into these "Other Cost" calculations (as well as to the subsidy assumptions in Scenario 3). These assumptions were based on information provided by advisory panel members, the MDA, and the resource documents reviewed.

To be able to compare the three scenarios, the simulation findings for Scenarios 1 and 2 were extrapolated over the same six-year horizon of Scenario 3. Based on the simulation results, Scenario 3 has the lowest "Six-Year Subsidized Cost" (farmers' implementation costs minus

subsidies) estimate with a mean value of $22.5 Million ($1.8 Million Standard Deviation) versus a mean value of $30 Million ($0.7 Million Standard Deviation) for Scenario 2, and a mean value of $51.6 Million ($1.4 Million Standard Deviation) for Scenario 1. The simulation results for the three scenarios can be found in Appendix E. The distributions of these "Six-Year Subsidized Costs" for the three scenarios are presented in Figure 3 below.

Figure 3: Distributions of the Six-Year Subsidized Costs

	25th Percentile	50th Percentile	75th Percentile
Scenario 1	$50.6 million	$51.5 million	$52.5 million
Scenario 2	$29.7 million	$30.2 million	$30.7 million
Scenario 3	$21.3 million	$22.5 million	$23.7 million

The S-Curves for these distributions can be found in Appendix F.

The Cost of Other Sectors Meeting the TDML Goals

The cost of meeting the Chesapeake Clean Water Blueprint goals through actions involving sectors other than agriculture was also examined. A communiqué from the Chesapeake Bay Commission states that "Maryland must reduce phosphorus by 589,000 lbs. (as of 2010) and must maintain that reduction even with added growth in development and wastewater." While these costs are important policy considerations, unless some of the projected savings from not

incurring them are applied directly to the mitigation of the costs of implementing the PMT, it is not appropriate to incorporate them into the three Scenarios analyzed in this analysis.

More information about this communiqué can be found in Appendix G.

Benefits of PMT Implementation

As discussed earlier, the MACRO Framework was utilized to estimate the costs and benefits of implementing the PMT to the resident of Maryland. There is ample evidence in the literature proving the economic value of clean water, and in particular, the economic benefits of meeting the Chesapeake Clean Water Blueprint goals for the entire Bay Watershed. Some of the most detailed and well defined estimates of these benefits can be found in an October 2014 Chesapeake Bay Foundation (CBF) report entitled *The Economic Benefits of Cleaning Up the Chesapeake.* According to this report, implementing the Blueprint will lead to $22 Billion in added annual economic value throughout the watershed. These values are derived from the enhanced natural benefits which include air and water filtering, recreation, seafood and farming production, aesthetics (including enhanced property values), clean drinking water, flood control, and pollution reduction. While the CBF study concentrates primarily on benefits, its authors estimate that the medium-term costs of implementation are likely to be around $5 Billion annually. Further, they estimate that, if the Blueprint is not fully implemented, pollution loads will increase and the value of the natural benefits will decline by $5.6 billion annually throughout the watershed.

The Maryland portion of the value of meeting the Blueprint goals ($4.6 Billion annually) is well documented in the CBF study. Unfortunately, it is difficult to isolate the portion of those benefits that can be directly attributed to the PMT implementation on the Eastern Shore of Maryland. Based on a series of assumptions provided by advisory panel members and a review of the available resources, and using the annual value figures from the CBF study, these annual statewide benefits of PMT implementation on the Eastern Shore were estimated to be about $100 Million after full implementation is achieved. In addition to the natural benefit categories

described in the CBF study, this $100 Million estimate includes Maryland based economic activity that could be triggered by spending related to PMT implementation (Please refer to Figures 1 and 2).

While significant, this statewide MACRO-Level benefit estimate attributable to the implementation of the PMT on the Eastern Shore cannot be directly compared to the farm-level costs of implementation estimated in the three scenarios. Most of the MACRO-Level benefit estimates involve value enhancements and potential cost savings. They are not financial resources that can be used to defray the farmers' PMT implementation costs. Some stakeholders believe that, given the greater uncertainty of the future benefit estimations, they should be discounted relative to the more predictable farm level costs.

The Prototype of a MICRO-Level Dashboard Template

In addition to the MACRO-Level estimates described above, a prototype PMT implementation dashboard template was developed. This template can be used in the future to estimate PMT implementation impacts at the farm-level. A sreenshot of the prototype PMT Farm Impact Dashboard Template, together with a discussion of the various elements of the dashboard can be found in Appendix H.

Study Limitations

Since the actual scenario of PMT Implementation has not yet been determined, the potential PMT implementation cost estimates calculated for this public policy briefing document was based on three specific likely scenarios provided by the Maryland Department Agriculture. There is no guarantee that any one of these scenarios will actually be the final chosen scenario. In addition, there are a large number of unknowns and uncertainties with each of the three given scenarios, making the estimates subject to significant variations.

There were different opinions and assumptions as well as a lack of trust among some of the stakeholders providing input for the study. To accommodate these different assumptions, wider than ideal ranges of probable values for each of the three scenario data nodes were used.

The three scenarios used in this study, by design, do not address other systemic issues where different stakeholders have differing opinions. The scenarios simply compare the estimated implementation costs versus the available subsidies for each scenario, independent of these differing systemic assumptions, and for a specific geography—the eastern Shore of Maryland. While it is important to address these differences in opinion at the public policy level, they remain outside the scope of this project.

The greatest limitation involves the scenario assumptions that pertain to estimating the incremental benefits of PMT implementation at the MACRO-Level. With all the uncertainties and unknowns previously discussed, determining the viable cost ranges of the PMT implementation that will be borne by farmers on the Eastern Shore is difficult enough. Determining the portion of the overall economic value of a clean Chesapeake Bay that can be attributed to PMT implementation is significantly more difficult.

Recent reports suggest that the Bay is on target with regards to some of the Bay Blueprint goals. The October 2014 CBF report, for the first time, quantifies the benefits of reaching the Chesapeake Clean Water Blueprint goals, as well as the costs of not reaching them, taking a

very large number of factors into account, covering the entire Bay watershed. Unfortunately, neither the CBF study nor the other studies reviewed for this study shed any light on how one would isolate the benefit of reducing one of the various pollution factors in a very small portion of the total watershed. So the question is how and when would property values, commercial fishing, recreational use, etc. increase in a predictable way if 228,000 tons of manure is removed from the nine counties of the Eastern Shore over the next six years?

It can be assumed that, at a minimum, the removal of the extra P will help maintain the overall economic value of the Bay. But, estimating the incremental improvements to this value attributable to various reduction levels of Phosphorus levels cannot be easily estimated? Some simple assumptions were used in this project to estimate such incremental values but these assumptions cannot be fully validated without further data based on actual implementation outcomes. As a result, this question remains insufficiently answered. Once MDA determines a final implementation scenario, and a few years' worth of data is available, this question should be revisited.

Finally, in a watershed that spans many states, the PMT will apply only to Maryland. Even though the other states in the watershed will still be responsible for the total amount of P that will reach the Chesapeake Bay, some stakeholders believe the farmers there will not be subjected to the level of scrutiny that Maryland farmers will face. The Maryland farmers are concerned about the competitive disadvantage this will cause them in a regional commodity market environment. Since the extent of such production migration and the magnitude of the associated harm are difficult to predict at this point in time, the simulation models for the three scenarios used in this analysis do not include the potential impacts of such economic disadvantages.

Future Economic Data Collection Protocols for PMT Implementation

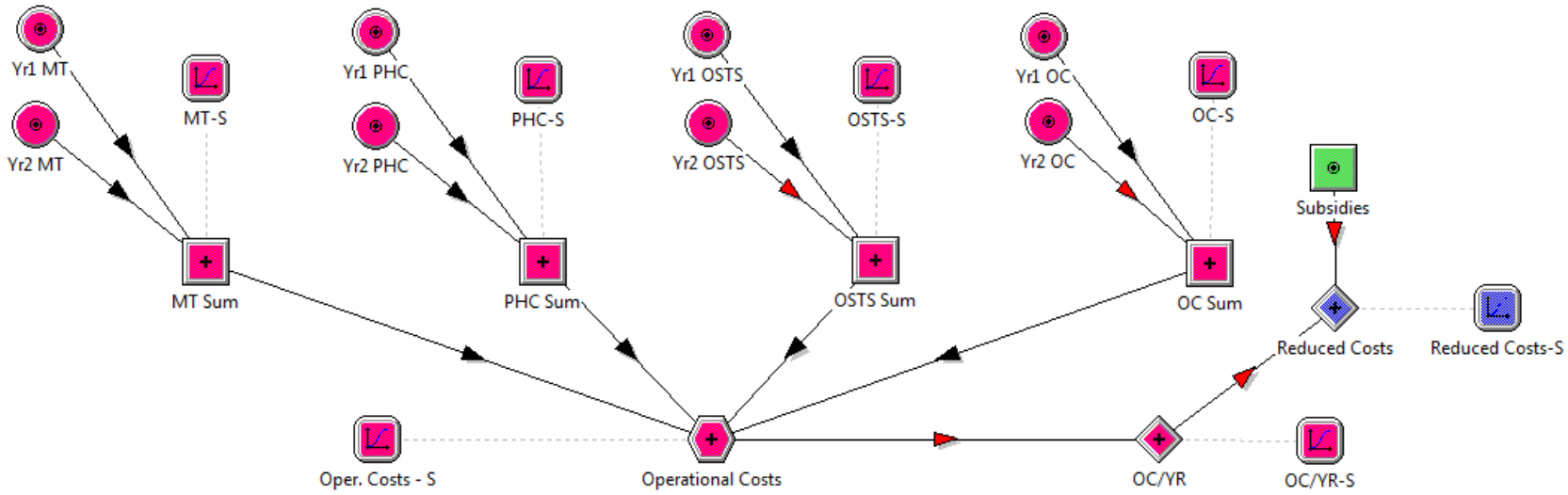
This project was designed to yield a public policy briefing document. It was not meant to serve as a comprehensive economic impact study. The lack of actual implementation data and the

wide variations in the assumptions of the different stakeholders about the costs (and benefits) of PMT implementation are serious limitations not only to this current endeavor, but to a future, more comprehensive economic impact study as well. If, as the PMT is implemented, well designed data collection protocols are established, data on actual implementation costs can be compiled. With three to five years of actual implementation cost data, a panel of agriculture and environmental economists would be able to conduct a comprehensive economic impact study. Such a comprehensive economic impact study would be far superior to the scenario analysis (with wide ranges of estimated values) used in this document. Such a study, using an IMPLAN (IMpact analysis for PLANning) economic impact model, would be able to measure both direct and secondary impacts of PMT implementation over time. Another benefit of such a study would be the incorporation of findings from current and future research on the costs of further reducing P deliveries to the Bay by other means (e.g. buffers, reduced tillage, etc.). It is also assumed that the potential impact of new technologies, the calibration of the PMT, and other uncertainties will be better known with a few years of actual implementation. These changing variables might change the cost of PMT implementation by reducing the amount of litter that would have to be transported away from the farms impacted. Lastly, such a future study could include the costs and benefits of innovation with a higher degree of accuracy. The effects of such future innovations are difficult to predict. But, once there is actual data from farmers and other entrepreneurs who might develop other ways to use litter, estimating the PMT implementation cost impacts of their innovations would become easier.

APPENDIX A

Influence Diagrams of the Three Scenarios

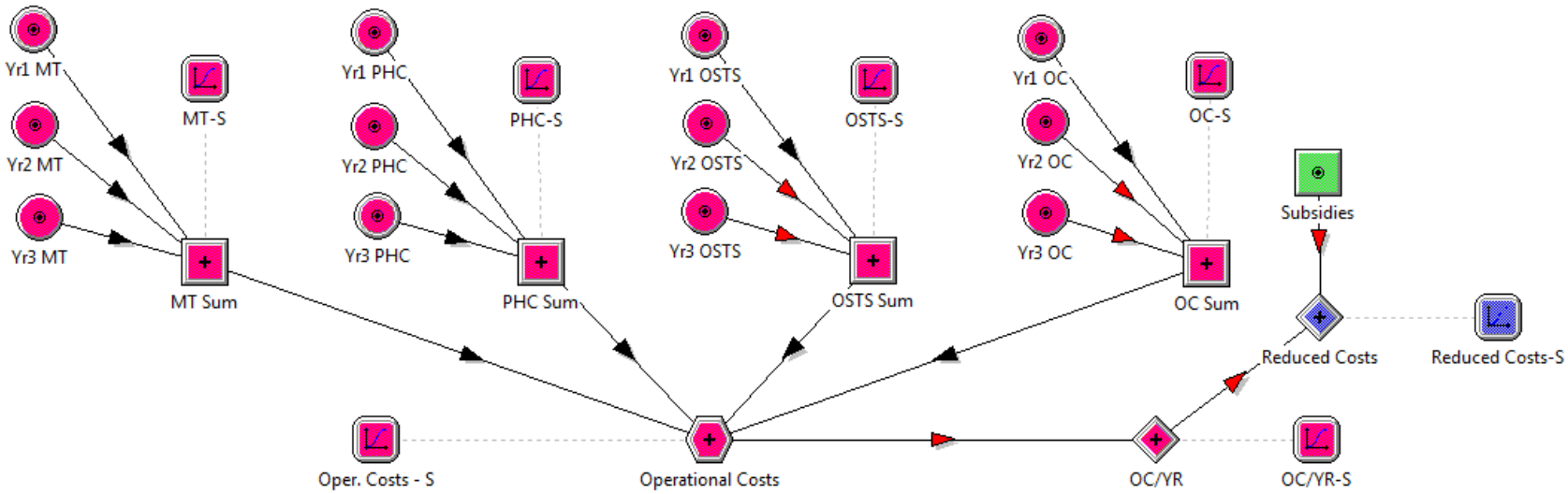
Scenario 1:



APPENDIX A

Influence Diagrams of the Three Scenarios

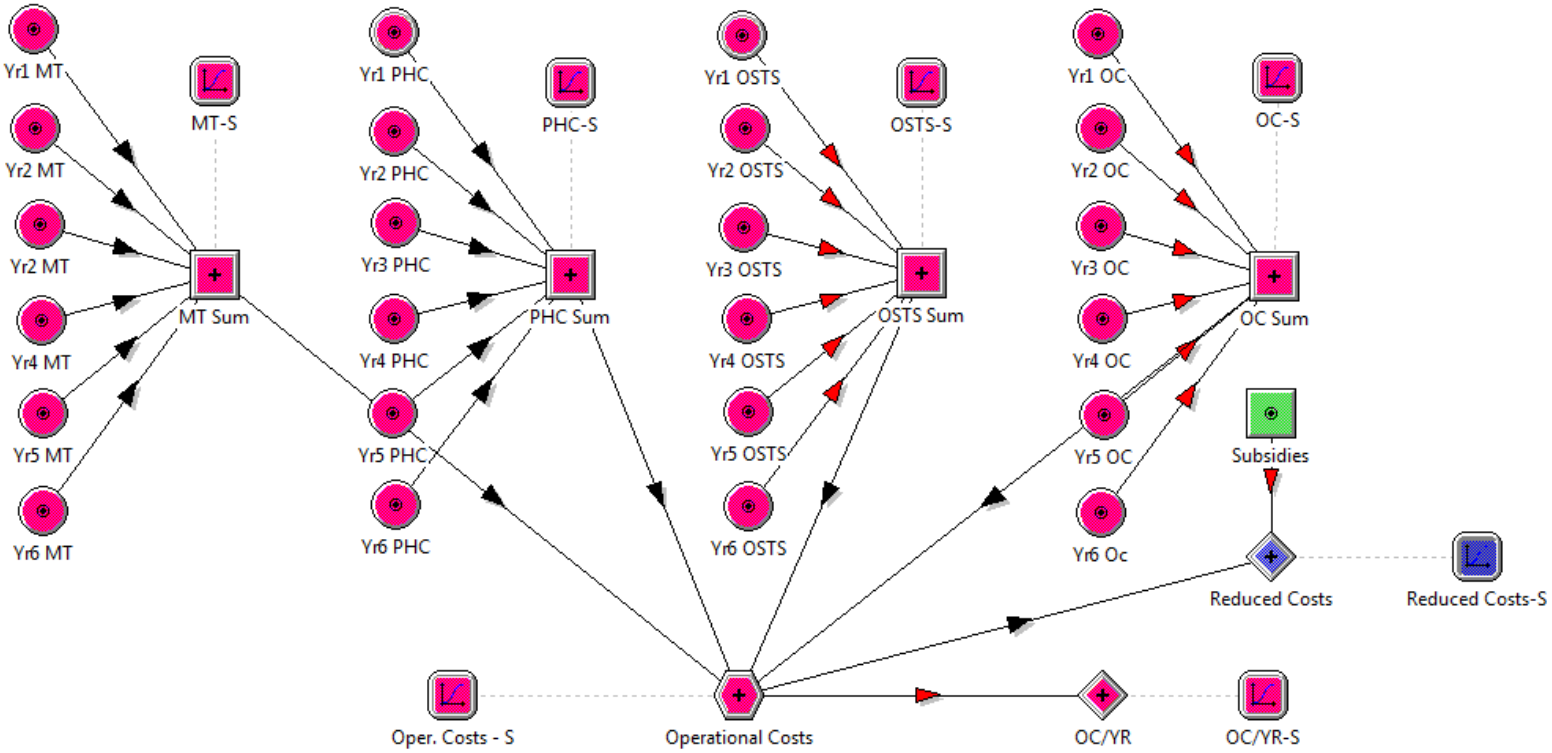
Scenario 2:



APPENDIX A

Influence Diagrams of the Three Scenarios

Scenario 3:



APPENDIX B

Descriptions of the Data Node Labels Used in All Three Scenarios

Node Label	Description
Reduced Costs	Six-Year Subsidized Costs
Subsidies	Subsidy and Incentive Programs Offered by the State
OC/YR	Operational Costs Per Year
Operational Costs	Operational Costs
OC Sum	Total of Other Costs
YrN OC	Other Costs for Year N
OSTS Sum	Total On-Site Temporary Storage Costs
YrN OSTS	On-Site Temporary Storage Costs for Year N
PHC Sum	Total of Poultry House Cleanout Costs
MT Sum	Total of Manure Transportation Costs
YrN PHC	Poultry House Cleanout Costs for Year N
YrN MT	Manure Transportation Costs for Year N

Appendix C

MDA Estimates for Programmatic Strategies for Cost Sharing, Offsets, Other Incentive-Based Approaches, and Alternative Use Technologies

PMT Program Support Timeline 6 Year Implementation Schedule - Scenario 3							
Program Description	2016	2017	2018	2019	2020	2021	Total
Manure Transportation	$1,784,000	$2,424,000	$3,064,000	$3,384,000	$4,024,000	$4,664,000	$19,344,000
Manure Handling and Trans. -Infrastructure Dev.	$56,050	$168,150	$224,200	$112,100	$0	$0	$560,500
Early Adopter Incentive	$1,000,000	$750,000	$750,000	$0	$0	$0	$2,500,000
Poultry House Cleanout	$0	$30,000	$75,000	$120,000	$180,000	$300,000	$705,000
Regional Temp.Storage							
Set Up	$0	$450,000	$0	$0	$0	$0	$450,000
Operating	$0	$150,000	$150,000	$150,000	$150,000	$150,000	$750,000
On-Site Temp. Storage	$0	$50,000	$100,000	$100,000	$150,000	$100,000	$500,000
NMP revisions	$1,796,250	$1,995,000	$2,127,500	$2,458,750	$2,790,000	$2,790,000	$13,957,500
Alternative Use Technologies-AWTF	$2,500,000	$2,500,000	$2,500,000	$2,500,000	$2,500,000	$2,500,000	$15,000,000
Clean Bay Power Procurement	$0	$3,000,000	$3,000,000	$3,000,000	$3,000,000	$3,000,000	$15,000,000
Maryland Industrial Partnerships	$750,000	$750,000	$750,000	$750,000	$750,000	$750,000	$4,500,000
USDA - Rural Energy for America Program (REAP)	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$3,000,000
USDA - RD, Value Added Producer Grants (VAPG)	$400,000	$400,000	$400,000	$400,000	$400,000	$400,000	$2,400,000
							$39,900,000
Total	$8,786,300	$13,167,150	$13,640,700	$13,474,850	$14,444,000	$15,154,000	$78,667,000

Appendix C

MDA Estimates for Programmatic Strategies for Cost Sharing, Offsets, Other Incentive-Based Approaches, and Alternative Use Technologies

PMT Program Funding Sources 6 Year Implementation Schedule - Scenario 3				
Program Decsription	Funding Status	Total	State	Federal
Manure Transportation	Current Funding	$8,784,000	$8,784,000	$0
	New Funding	$10,560,000	$10,560,000	$0
Manure Handling and Trans. -Infrastructure Dev.	New Funding	$560,500	$560,500	$0
Early Adopter Incentive	New Funding	$2,500,000	$2,500,000	$0
Poultry House Cleanout	New Funding	$705,000	$705,000	$0
Regional Temp.Storage	New Funding			
Set Up		$450,000	$450,000	$0
Operating		$750,000	$750,000	$0
On-Site Temp. Storage	Current Funding	$500,000	$500,000	$0
NMP revisions	Current Funding	$8,790,000	$2,040,000	$6,750,000
	New Funding	$5,167,500	$0	$5,167,500
Sub-Total - Farm-Related Costs		$38,767,000	$26,849,500	$11,917,500
Alternative Use Technologies-AWTF	Current Funding	$15,000,000	$15,000,000	$0
Clean Bay Power Procurement	Current Funding	$15,000,000	$15,000,000	$0
Maryland Industrial Partnerships	Current Funding	$4,500,000	$4,500,000	$0
USDA - Rural Energy for America Program (REAP)	Current Funding	$3,000,000	$0	$3,000,000
USDA - RD, Value Added Producer Grants (VAPG)	Current Funding	$2,400,000	$0	$2,400,000
Sub-Total -Alternative Technologies		$39,900,000	$34,500,000	$5,400,000
Total		$78,667,000	$61,349,500	$17,317,500

Appendix C

MDA Estimates for Programmatic Strategies for Cost Sharing, Offsets, Other Incentive-Based Approaches, and Alternative Use Technologies

PMT - Current Vs. New Program Cost and Fund Source Summary 6 Year Implementation Schedule - Scenario 3			
	Total	State	Federal
Farm-Related Costs			
Current Funding	$18,074,000	$11,324,000	$6,750,000
New Funding	$20,693,000	$15,525,500	$5,167,500
Sub-Total	$38,767,000	$26,849,500	$11,917,500
Alternative Technologies			
Current Funding	$39,900,000	$34,500,000	$5,400,000
New Funding	$0	$0	$0
Sub-Total	$39,900,000	$0	$0
Total Current Funding	$57,974,000	$45,824,000	$12,150,000
Total New Funding	$20,693,000	$15,525,500	$5,167,500
Total Funding	$78,667,000	$61,349,500	$17,317,500

Appendix D

Assumptions Used for the MDA Estimates for Scenario 3

1. Manure Transportation

- Volume of 228,000 tons of additional manure based on MDA data of annual poultry litter availability and Univ. of MD estimates of manure use no longer land applied under the PMT. Additional funding described will support relocation of this manure.
    i. 81% on Lower Eastern Shore
    ii. 41% on Upper Eastern Shore
- Average costs of $14/ton--assumes State pays 100% of costs of additional costs beyond current levels of support by the poultry companies and the State.

2. Manure Handling and Transportation Infrastructure Development

- Infrastructure development could be enhanced through tax incentives to offset capital costs of specialized equipment for manure handling and hauling.
- Adds certain equipment to income tax subtraction modification
- Assumes:
    i. 228,000 additional tons of poultry litter to transport.
    ii. 8,000 tons hauled per truck per year
    iii. $85,000 per truck trailer
    iv. One conveyor/loader per 3 trucks
    v. $40,000 per conveyor
- For Commercial Fertilizer Equipment
    i. Eligible operations have not used commercial fertilizer
    ii. Based on 1519 Non-CAFO operations and 507 CAFO operations in nine Eastern Shore counties. Assumes:
        1. 50% of CAFO operations include cropland (253)
        2. 10% of the total estimated number of farms would be eligible (1519+ (507 x .5)) x .1=177 operations)
    iii. $15,000 per spreader

3. Early Adopter Incentive

- Develop an incentive for farm operations to implement the PMT prior to the adopted schedule.
- Incentive payment to assist in offsetting costs of replacement commercial fertilizer
- Incentive is available only until PMT implementation is required

Appendix D

Assumptions Used for the MDA Estimates for Scenario 3

- Assumes:
    i. 100,000 acres affected by poultry litter
        1. (228,000 tons precluded from use)
    ii. 20% of affected acres will enroll.

4. Poultry House Cleanout Payment

- In situations where a poultry house clean out is scheduled and there are no viable management alternatives available to the contract producer, the State could provide funding to assist in the clean out of the poultry house and transport the litter from the farm. Such an incentive would be available only as a last resort and the contract grower would have to have demonstrated a good faith effort to find a market for the litter in order to be eligible.
- Designed to address perceptions of market disruptions to barter type relationships for "no-land" operations when no immediate destination is available for litter and house must be cleaned out.
- Intended to operate in conjunction with state-operated temporary storage facilities.
- Assumes:
    i. 228,000 tons of new excess litter
    ii. 10% of new excess affected.
    iii. $13 per ton – clean out and loading cost. (Univ. of MD/U DE data)

5. Regional temporary state-operated storage facilities

- In the event that a poultry producer must clean out the house and has no market or receiver for the litter removed from the house, state-operated facilities would be utilized to receive litter.
- Provide three locations – one in each of Wicomico, Worcester and Somerset counties.
- Facilities established as scalable operations
- Initially designed to handle 30,000 tons of litter (10,000 tons each)
- Assumes:
    i. $150,000 per site set up cost
    ii. Storage provisions as established by nutrient management regulations
    iii. Sale of material received to offset operating costs
    iv. Net operating costs - $50,000 per site per year

Appendix D

Assumptions Used for the MDA Estimates for Scenario 3

6. On Site Temporary Storage

- Provide cost share assistance to install on-farm impermeable pads for temporary storage of poultry litter removed from house clean outs
- Based on 10% of approximately 500 poultry operations:
    i. 41% of 235 poultry operations on Upper Eastern Shore (96)
    ii. 81% of 479 poultry operations on Lower Eastern Shore (388)
- Assumes $10,000 per operation.

7. Nutrient Management Plan Updates to Reflect PMT

- Provide incentive payment to offset costs of revising certain NMPs affected by the PMT.
- Based on 1350 operations
- Assumes 25% of operations requiring NMPs will be affected by PMT and require plan revisions. $1,000 per plan revision

8. Alternative Use Technologies

- Making continued investments in alternative use technologies will accelerate deployment of a broader set of solutions to excess animal manures, and potentially develop new sources of revenue to offset other costs. There are competitive grant processes in place from a variety of fund sources, all of which qualify animal manure as a fuel source.

Appendix E

Simulation Results for the Three Scenarios

Scenario 1 Simulation Results

Name	Unit	Mean	Std. Dev.
Six-Year Subsidized Cost	$	51,571,862.12	1,423,246.73
Subsidies	$	2,926,535.49	111,653.01
Operational Costs	$	18,166,132.54	473,683.47
OC Sum	$	7,986,213.62	317,620.53
OSTS Sum	$	571,654.70	22,214.17
PHC Sum	$	300,576.97	11,908.70
MT Sum	$	9,307,687.24	364,523.07

Scenario 2 Simulation Results

Name	Unit	Mean	Std. Dev.
Six Year Subsidized Costs	$	30,170,145.96	735,153.29
Subsidies	$	5,856,248.37	228,100.79
Operational Costs	$	18,013,197.16	346,299.24
OC Sum	$	7,973,261.87	225,439.03
OSTS Sum	$	570,839.82	15,894.84
PHC Sum	$	149,884.48	5,879.02
MT Sum	$	9,319,210.99	260,331.02

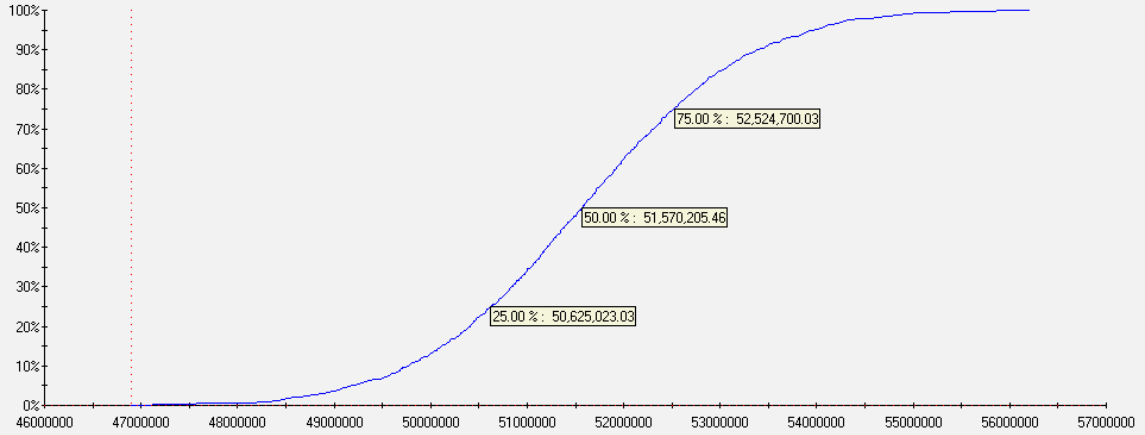
Scenario 3 Simulation Results

Name	Unit	Mean	Std. Dev.
Six-Year Subsidized Costs	$	22,496,960.79	1,752,244.16
Subsidies	$	39,995,351.31	1,571,239.95
Operational Costs	$	62,492,312.10	761,952.97
OC Sum	$	22,570,028.81	415,619.86
OSTS Sum	$	571,119.01	10,384.54
PHC Sum	$	705,026.23	14,625.74
MT Sum	$	38,646,138.06	627,717.72

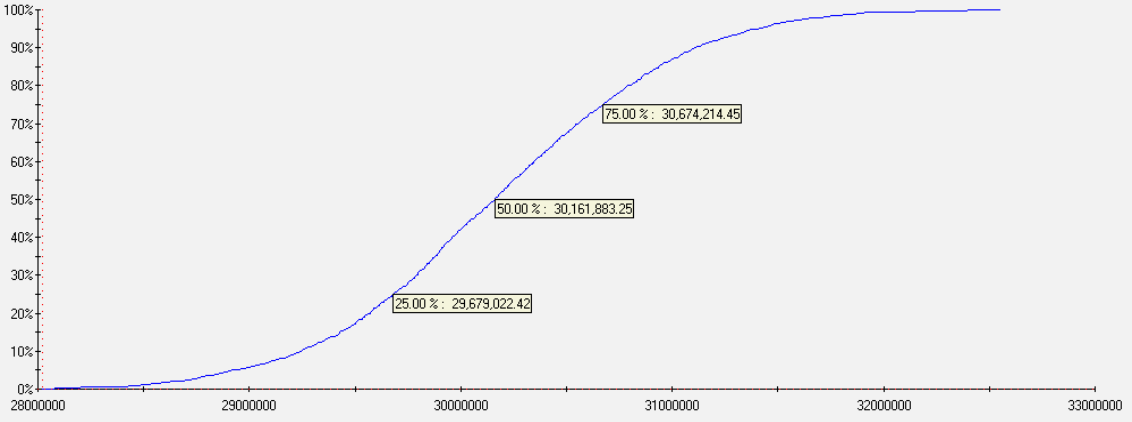
Appendix F

S-Curve Comparisons of the Six-Year Subsidized PMT Implementation Costs

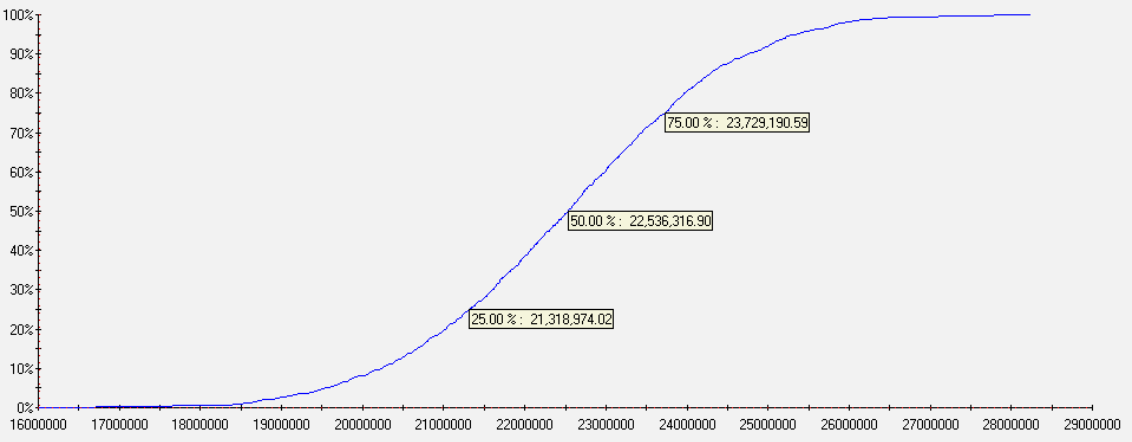
Scenario 1 Six-Year Subsidized Costs (PMT Implementation Costs minus Subsidies)



Scenario 2 Six-Year Subsidized Costs (PMT Implementation Costs minus Subsidies)



Scenario 3 Six-Year Subsidized Costs (PMT Implementation Costs minus Subsidies)



APPENDIX G

Excerpts from a July 2014 Communiqué from the Chesapeake Bay Commission

(…)

Maryland must reduce phosphorus by 589,000 lbs. (as of 2010) and must maintain that reduction even with added growth in development and wastewater. This load was divided by the state and assigned to each source sector in a manner that required an equitable level of effort from each source sector, and that was effective and consistent with achieving water quality standards.

Under such a scenario, if the agricultural sector does not make the necessary reductions to meet the TMDL, the state must still achieve the load reductions to meet the WIP and two year milestones and may need to obtain the required reductions from another source sector. If reductions are not achieved the State of Maryland could incur federal actions designed to ensure that pollutant load reductions are made.

Chesapeake Bay restoration is being guided by EPA's Accountability Framework, which consists of the state developed Watershed Implementation Plans (WIP's), the two year milestones that each state sets to meet the load reduction schedule, and EPA's commitment to track and assess restoration progress and to take federal actions referred to as "backstops" if progress is not being made.

Implementing the PMT was identified in Maryland's WIP and in the planned milestones for the 2012-2013 timeframe but, obviously, was not achieved. The PMT can also be considered one of the mechanisms that could ensure that non-point source load allocations are achieved.

EPA's most recent evaluation of Maryland's 2012-2013 Milestones indicates that the PMT was a strategy that was planned for in the 2012-2013 Milestones but was not achieved. Adopting the regulations to implement the PMT regulations is now included in the 2014-2015 milestones. (see page 1, http://www.epa.gov/reg3wapd/tmdl/2014Evaluations/MD.pdf)

EPA also noted in this same document that "Maryland will need to continue to advance implementation in all sectors to stay on track to meet its Watershed Implementation Plan (WIP) and Chesapeake Bay Total Maximum Daily Load (Bay TMDL) commitments by 2025."

(…)

EPA could:

- Expand NPDES permit coverage to currently unregulated sources -For example, utilizing "Residual Designation Authority" to increase the number of sources, operations and/or communities regulated under the NPDES permit program;

- Object to NPDES permits and increase program oversight -Pursuant to EPA~ Jurisdiction NPDES program agreements, expanding EPA oversight review of draft permits (major and minor) in the Bay watershed and objecting to inadequate permits that do not meet the requirements of the Clean Water Act (including but not limited to NPDES effluent limits that are not consistent with the Bay TMDL's waste load allocations);

APPENDIX G

Excerpts from a July 2014 Communiqué from the Chesapeake Bay Commission

- Require net improvement offsets -For new or increased point source discharges, requiring net improvement offsets that do more than merely replace the new or expanding source's anticipated new or increased loadings;

- Establish finer scale waste load and load allocations in the Bay TMDL -Establishing more specific allocations in the final December 2010 Bay TMDL than those proposed by the States and the District;

- Require additional reductions of loadings from point sources - Revising the final December 2010 Bay TMDL to reallocate additional load reductions from non-point to point sources of nutrient and sediment pollution, such as wastewater treatment plants;

- Increase and target federal enforcement and compliance assurance in the watershed - This could include both air and water sources of nutrients and sediment;

- Condition or redirect EPA grants -Conditioning or redirecting federal grants; incorporating criteria into future Requests for Proposals based on demonstrated progress in meeting Watershed Implementation Plans and/or in an effort to yield higher nutrient or sediment load reductions; and

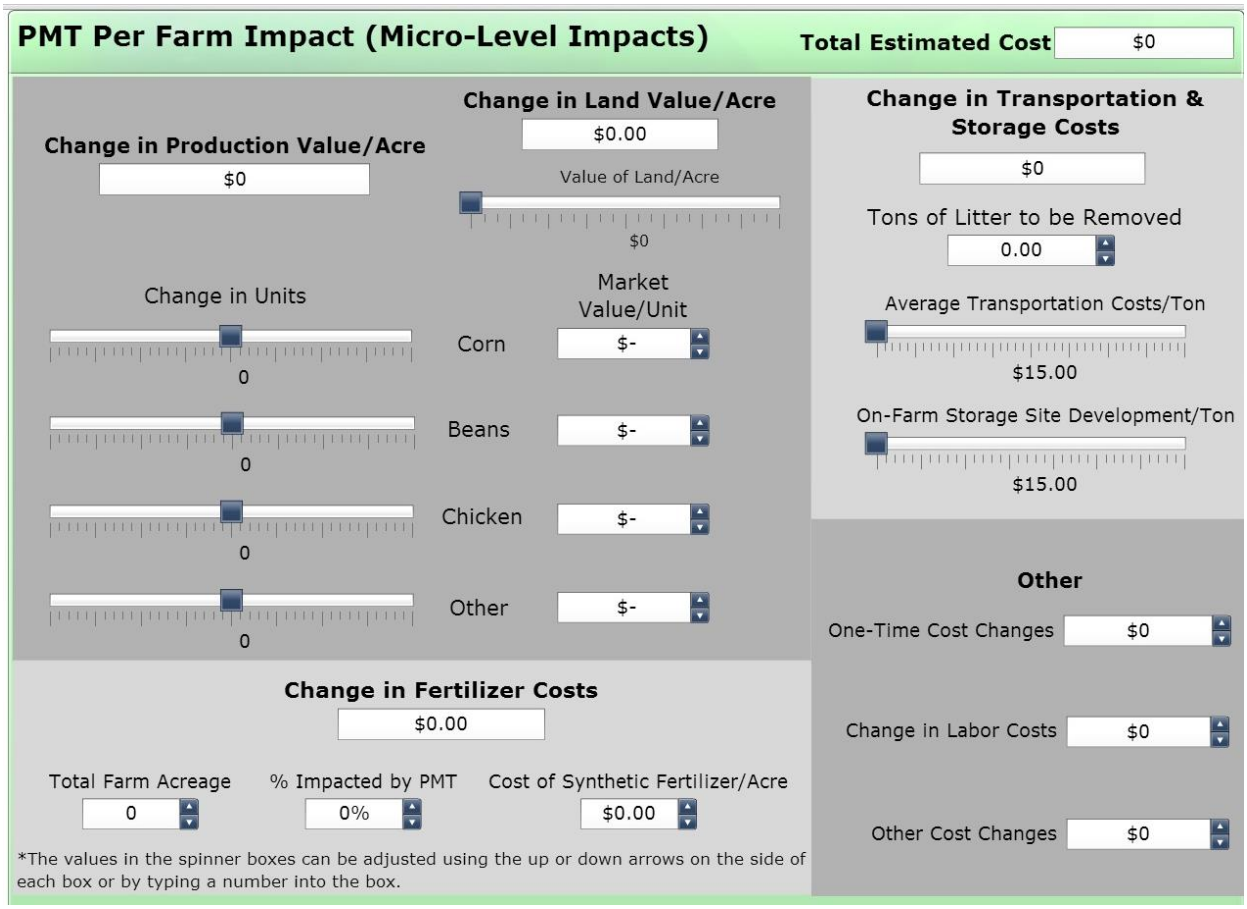
- Federal promulgation of local nutrient water quality standards -Initiating promulgation of federal standards where the State or the District water quality standards do not contain criteria that protect designated uses locally or downstream.

Each of these actions is further explained in the 2009 letter from the EPA.
http://www.epa.gov/region03/chesapeake/bay_letter_1209.pdf)

Considering that implementing the PMT was in Maryland's 2010 WIP, and in our 2012-2013 Milestones, and the State has failed to date to meet the milestone, and that the state has now included passage of the PMT in the 2014-2015 milestones, and if a state fails to meet their milestones that EPA can take action to expand the areas covered by stormwater permits, require lower pollutant limits for NPDES permits, re-allocate load reductions from non-point load (Agriculture) to point sources like wastewater treatment plants, and require net improvement from offsets, this economic study should consider the scenario that other sectors may be required to make further reductions to cover the reductions needed from agriculture.

APPENDIX H

The Prototype of a MICRO-Level Impact Dashboard Template



Dashboard Elements

The "Change in Production Value/Acre" box displays the total change in production value as the sum of the change in each type of production multiplied by its respective market value. The formula is:

Change in Production Value/Acre = ((Change in Units of Corn x Market Value/Unit of Corn) + (Change in Units of Beans x Market Value/Unit of Beans) + (Change in Units of Chicken x Market Value/Units of Chicken) + (Change in Units of Other x Market Value/Unit of Other))

The sliders allow the user to select a value between -500 and 500 units of change in production for each type of product. The white boxes to the right indicate the value per unit and can be adjusted by clicking in the box and typing directly into it or using the up and down arrows on the side of the box. When adjusting the sliders and market values consistent units of measurement should be used for each type of crop.

APPENDIX H

The Prototype of a MICRO-Level Impact Dashboard Template

The "Change in Land Value/Acre" box displays the change in the value of each acre of land based on the change in production value associated with the land (as previously described). A positive change in production value is associated with a 2% increase in the value of each acre of land and a negative change in production value is associated with a 2% decrease in the value of each acre of land. The initial value of land per acre is set using the "Value of Land/Acre" slider.

The initial value change increments are set for demonstration purposes only. When the final implementation scenario is determined by MDA, and prior to the activation of the dashboard, the BEACON team will update these increments.

The "Change in Fertilizer Costs" box displays the total cost to a farm of replacing organic fertilizer with synthetic fertilizer. It calculates the total using the three components:

1. Total farm acreage
2. % impacted by PMT-this is the percent of the farm requiring synthetic fertilizer
3. Cost of synthetic fertilizer per acre. This has a default starting value of $12.00 but can be adjusted using the arrows on the right-hand side of the box in increments of $0.01

All three components can be adjusted by clicking in the box and typing directly into it or using the up and down arrows on the side of the box.

The "Change in Transportation and Storage Costs" box displays the total cost to the farm of removing and/or storing organic fertilizers. The sum calculates as the total tons of organic fertilizer to be removed multiplied by the average cost of transportation the on-farm storage site development costs per ton of litter.

The formula is:

Change in Transportation and Storage Costs = (Tons of organic fertilizer to be removed x (the Average Cost of Transportation per Ton + The On-Farm Storage Site Development per Ton))

All of the "other" cost categories can be changed by either:

1. Using the up and down arrows on the side of the box;
2. Clicking inside the white box and typing a number.

As mentioned above, this is only the template for a prototype dashboard. Once a final PMT implementation scenario is determined by the Maryland Department of Agriculture, the BEACON team will update and activate a dashboard that reflects the actual scenario and publish a User's Manual. Such a dashboard can then be used by farmers and other stakeholders to calculate PMT implementation costs for a specific farm or field.

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