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Chesapeake Bay Tributary Strategy Compliance Cost Study

Conducted Pursuant to SR 2008-224

November 2008

Legislative Budget and Finance Committee

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To the Members of the General Assembly:

Senate Resolution 224 of 2008 directs the Legislative Budget and Finance Committee to study the cost for wastewater treatment plants to comply with Pennsylvania's Chesapeake Bay Tributary Strategy.

Due to the specialized nature of this study, the Committee issued a Request for Proposal for assistance in developing the report. In June 2008, the Committee contracted with the firm of Metcalf & Eddy | AECOM to conduct this study.

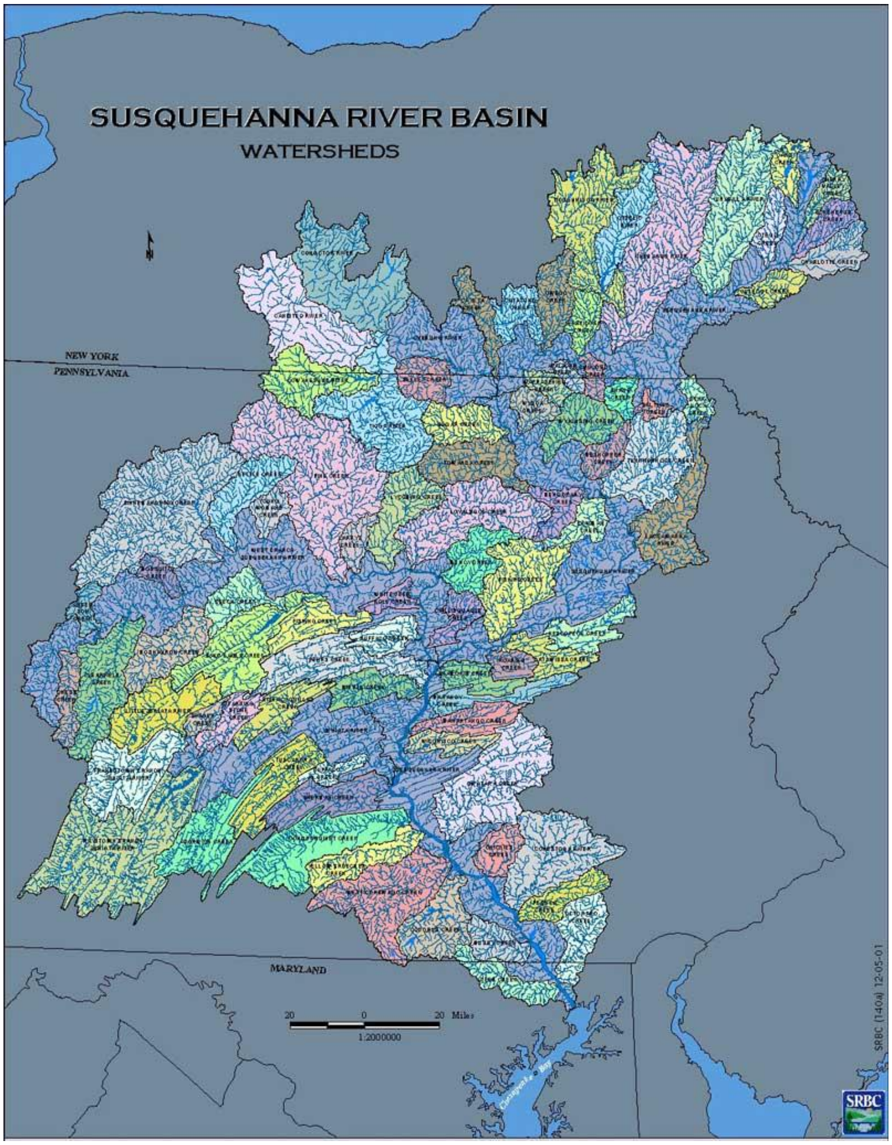
The Metcalf & Eddy | AECOM report is contained herein. As with all LB&FC reports, the release of this report should not be construed as an indication that the Committee or its individual Committee members necessarily concur with its findings and recommendations.

Sincerely,

Philip Durgin

Philip R. Durgin
Executive Director

Chesapeake Bay Tributary Strategy
Compliance Cost Study



November 2008

Prepared by:

METCALF & EDDY | AECOM and Legislative Budget and Finance Committee

CONTENTS

1.0 EXECUTIVE SUMMARY 1

2.0 BACKGROUND 6

3.0 OBJECTIVES AND APPROACH 8

4.0 SURVEY AND RESPONSES 9

5.0 CAPITAL COST ANALYSIS AND INITIAL ESTIMATES 14

6.0 SITE VISITS AND REFINEMENT OF NUTRIENT-RELATED CAPITAL COST ESTIMATE 18

7.0 OPERATIONS COST ANALYSIS 20

8.0 USER RATE COST ANALYSIS 21

9.0 CONSIDERATION OF ALTERNATIVES TO FACILITY UPGRADES 22

10.0 NUTRIENT CREDIT TRADING PROGRAM ASSESSMENT 27

10.1 Assessment of Trading as a Viable Alternative 27
10.2 Factors to Consider for Point Source to Non-Point Source Trading 30
10.3 Nutrient Credit Generation Potential for Agricultral Practices in the Pennsylvania Nutrient Trading Program 33
10.4 Issues that May Affect Likelihood of Point Source to Non-Point Source Trading 44
10.5 Point Source Dischrgers to Non-Point Source Trading Price Analysis 47
10.6 References 51

11.0 POTENTIAL SOURCES OF FINANICAL SUPPORT (by LB&FC) 51

11.1 Introduction 51
11.2 Funding Programs in Maryland 51
11.3 Funding Programs in Virginia 52
11.4 Potential Funding Sources in Pennsylvania 53
11.5 Summary 55
11.6 References 55

12.0 RESPONSE TO THIS REPORT 57

TABLES

4-1. Summary of Survey Response Rates 10
7-1. Reported Increase in Annual O&M Cost per Facility, by Flow Groups 21
10-1. List of Factors to Consider for Point Source to Non-Point Source Trading 30
10-2. Summary of Estimates for Credit Generation Potential of Nutrient Trading Credits in the Pennsylvania Nutrient Trading Program 36
10-3. Potential Nutrient Trading Credits from Land-Based Best Management Practices 39
10-4. Assumptions for Nutrient Trading Credit Estimates 40
10-5. Prices for Completed PADEP Trades 48

FIGURES

4.1. Response Rates by Flow Group 12
4.2. Responses to Survey Question B16 (Status of Facility Improvements) 13
5.1. Reported Nutrient-Related Capital Cost vs. Design Average Flow on August 29, 2005 15
5.2. Reported Nutrient-Related Capital Cost vs. Design Average Flow on August 29, 2005 (for 0.4 to 10 mgd, with Cost Equation) 16
5.3. Regression and Cost Equation 17
9.1. Consideration of Facility Operational Changes 24
9.2. Consideration of Elimination of On-Lot Septic Systems 25
9.3. Consideration of Seasonal Application of Treated Wastewater 26
10.1. 2009-Indexed Annual Cost for Nutrient-Related Upgrades versus Percentage of Representative Sample (Full Scale) 49
10.2. 2009-Indexed Annual Cost for Nutrient-Related Upgrades versus Percentage of Representative Sample (Reduced Scale) 50

APPENDICES
(Contact Legislative Budget & Finance Committee regarding availability)

A Alternate Allocation Strategy Table
B Survey Form
C Survey Database and Original Responses (on CD)
D Site Visit Memoranda (on CD)
E Point Source Survey Questions and Summary of Responses, and Response Details
F Point Source Survey List of Responders, Interviews, and Interview Summaries (on CD)
G Supporting Data for Estimating Non-Point Source Nutrient Credit Generation
H Nutrient Trading Assessment Interviews (on CD)
I Certified Nutrient Credits From PADEP Registry on September 25, 2008
J Statistical Analysis by Pennsylvania State University Statistical Consulting Center

1.0 EXECUTIVE SUMMARY

Introduction

Policy makers, regulatory officials, municipal executives, and wastewater treatment professionals recognize that a reduction in nutrient load from dischargers will benefit the Chesapeake Bay and that widespread wastewater treatment facility upgrades will be a significant contributor to achieving the point source effluent nutrient cap loads targeted by the Chesapeake Bay Tributary Strategy. However, there has been differing opinions on the cost impact of CBTS compliance on municipal point source dischargers. Estimates ranged from as low as $190 million to $1 billion or more. Also, amendments to the CBTS included provisions for a nutrient credit trading program, with the intent being that the nutrient credit trading program could serve as a more cost-effective alternative to wastewater treatment facility upgrades for dischargers seeking CBTS compliance. As of early 2008, dischargers did not appear to be using the nutrient credit trading program at the rate originally anticipated by DEP.

In response to concerns from municipalities and municipal authorities within their districts facing the financial impacts of the Chesapeake Bay Tributary Strategy compliance, a group of Pennsylvania State Senators introduced (and the Senate later adopted) Senate Resolution No. 224 of the Session of 2008 (SR 224), which directed the Legislative Budget and Finance Committee (LBFC) to study the cost for municipal point source dischargers to comply with CBTS. Specifically, SR 224 required the LBFC to:

1. Estimate the costs that dischargers will incur to comply with CBTS

2. Assess the methods by which dischargers may achieve CBTS compliance, including physical treatment facility improvements as well as alternatives such as nutrient trading

3. Identify financial resources available to dischargers in Pennsylvania seeking CBTS compliance, as well as financial resources that other states in the Chesapeake Bay watershed have committed to assist wastewater treatment plants in achieving compliance with applicable effluent limitations

Due to the time constraints of SR 224 and technical knowledge and expertise required to assess wastewater treatment facility improvements, LBFC retained the services of Metcalf&Eddy|AECOM (M&E) to assist in the completion of the directives of SR 224. M&E's scope of work was to complete item numbers 1 and 2 above, with the LBFC staff to complete item number 3 above. M&E engaged two subconsultants to support fulfilling this scope of work. In support of the first task, the Pennsylvania State University Statistical Consulting Center (PSU-SCC) provided a statistical review and confidence limits to the estimated cost of compliance. As a major part of Task 2, Material Matters, Inc. prepared the nutrient trading assessment.

The remainder of this section summarizes the key conclusions and findings of the Chesapeake Bay Tributary Strategy Compliance Cost Study.

Estimated Cost of Chesapeake Bay Tributary Strategy Compliance by Plant Upgrades

The 2009-indexed nutrient-related capital cost estimate for the body of "significant municipal dischargers" is $1.40 billion ± $0.14 billion at the 95% confidence interval. On a capital cost basis, three percent of the upgrades have been completed. Therefore, 97% of the nutrient-related estimate represents a potential nutrient-related funding need.

The 2009-indexed total project cost estimate (i.e., the total cost for the planned project consisting of nutrient-related and non-nutrient related upgrades) for the body of significant dischargers is $1.96 billion. Because of the approach to estimating the total project cost, a confidence interval was not determined; however, it would be reasonable to expect a confidence interval proportional to that of the nutrient-related cost estimate.

The approach to cost estimating, described in greater detail in the report, generally consisted of:

- Surveying dischargers to obtain reported capital costs
- Indexing reported costs to 2009 dollars
- Using the indexed reported to costs to generate a cost equation to estimate costs for non-respondents
- Statistical analysis to estimate nutrient-related cost for the body of significant municipal dischargers and determine confidence interval associated with the cost estimate
- Refinement of cost estimate based on site visits to representative sample of 20 dischargers

Depending on the existing treatment process and the processes selected for nutrient removal upgrades, operation and maintenance (O&M) costs will be impacted. Based on M&E's treatment of reported O&M costs, described in greater detail in Section 7, the total estimated annual O&M increase for nutrient removal for the body of significant dischargers is $61 million per year.

Dischargers also had the opportunity to report their current residential user rate schedule and the actual or projected rate increase associated with completed or planned upgrades. Responses to projected rate increases ranged from no increase (for those plants already meeting nutrient removal requirements) to three hundred percent (300%) increase in user rates. The average reported rate increase was 48%.

Because reported rate increases are a function of current user rates, it was difficult to draw conclusions based on reported rate increases. Certainly, any significant upgrade project, largely driven by nutrient cap loads, will have an impact on rates. However, if user rates have not been increased for a long duration, the reported percent increase in the user rate will be skewed high.

Therefore, M&E sought an alternate approach to quantifying cost impacts on a "user" basis. The basis of "household equivalent" (HHE) was chosen and defined as 175 gallons per day as described in Section 8. Using this basis, and the assumption of financing of capital costs at rates and terms typical of PennVEST loans, the following annualized costs were estimated:

- Estimated annualized 2009-indexed nutrient-related user cost (capital plus O&M) is $68/HHE/yr. ($40 capital related, $28 O&M related)
- Estimated annualized 2009-indexed total project-related user cost (capital plus O&M) is $84/HHE/yr ($56 capital related, $28 O&M related)

These numbers must be used with caution as they represent estimated average values for the entire body of significant dischargers. Actual discharger-specific impacts to user rates will vary significantly for dischargers depending on current rates, rate increase history, and the discharger-specific capital and O&M costs.

Nutrient Credit Trading Program Assessment

The Pennsylvania Nutrient Trading Program (PANTP) is intended to facilitate the generation of nutrient credits from non-point, agricultural sources (NPS) that can be purchased by municipal wastewater agencies in lieu of expending capital to upgrade facilities for nutrient treatment. This approach was anticipated to be a cost-effective complement to plant upgrades and would reduce the overall cost of meeting the State's nutrient reduction goals.

Our methodology, as detailed in the body of this report, involved 1. Documenting the current status of trading and surveying the perceptions and perspectives of the municipal wastewater community; 2. Conducting interviews with involved, knowledgeable parties (academic, governmental and private program participants, consultants and designers); 3. Gathering data on agricultural demographics and nutrient management; and 4. Studying the assembled body of data for trends and implications.

As of September, 2008 this program has had limited impact – only six trades have been recorded since program inception. PADEP approved credits are currently available for sale however, there is currently little demand. Uncertainty surrounding the future credit price and reliable supply of credits causes concern about the viability of the program among the long-term focused, regulated, and risk adverse municipal wastewater community. Uncertainties are not just associated with cost, so that even if costs are acceptable to the buyer and seller, nutrient trading appears to be restricted.

Survey respondents and interviewees frequently pointed to the potential for regulatory and policy changes as a major source of uncertainty. Looming total maximum daily load (TMDL) requirements and the prospect of policy changes with respect to NPS requirements for trading were often cited. Without assurance that future regulations and policies related to TMDLs and NPS requirements will not adversely affect nutrient trades, the wastewater community is likely to maintain its general aversion to considering purchasing credits in lieu of capital upgrades. Underscoring the importance of creating more certainty, we found considerable appeal among the municipal wastewater community for reducing uncertainty by creating a government-supported clearinghouse for purchasing, selling, and setting the long term prices of nutrient credits and guaranteeing their availability.

This study has identified a number of structural issues associated with the PANTP as it is currently organized that affect the likelihood of municipal wastewater facilities using this alternative. These structural issues can be grouped into five issue areas associated with the PANTP and the regulatory framework that the municipal wastewater community operates within. These issue areas are elaborated on in the body of this report but can be summarized as –

- Regulatory framework & uncertainties (e.g., TMDLs)
- PANTP implementation policies (certification and verification standards, application limitations)
- Reliance on a market-based approach (limited availability of long term assurances of pricing and supply in an "infant" market)
- PANTP guidelines and support (need for outreach to improve understanding, clear guidelines and technical support for potential traders)
- Agricultural restrictions and support (disincentive creating baseline requirements, need for guidance and support)

We also found two structural issue areas that stem from the nature and demographics of municipal wastewater management and agriculture. These issues will need to be taken into account when considering and shaping program-enhancing modifications –

- Farming demographics and culture (small per acre potential for credits, aversion to compliance-based programs)
- Wastewater management culture (limited knowledge of influential advisors, risk aversion and propensity to control risk on-site)

Supply of agricultural-based (NPS) credits may be limited due to uncertain costs of bringing farms to baseline (which is required before credits can be generated) as well as the relatively small number of credits that can be generated with BMP implementation. Credits generated by treating manure or moving manure out of the watershed show more promise, but uncertainties discussed above (and perceptions in the municipal wastewater community that relocating manure is a questionable environmental practice) pose challenges.

The fundamental premise of the PANTP is that compliance will take place through the least costly option when free-market forces are in play. Our cost of compliance estimates indicate that a majority of municipal wastewater facilities, representing about 1/3 of the nutrient reduction goal, would have a purely financial incentive (i.e., exclusive of any other factors such as uncertainty, risk, etc.) at current pricing to purchase nutrient credits, and sufficient agricultural-based credits are available (primarily from manure relocation or treatment; however, when uncertainty and risk are factored in, trading is rarely viewed as attractive by the municipal wastewater community.

The PANTP is a unique, one-of-a-kind program in the United States and may require additional educational and outreach effort. At this point, the municipal wastewater community does not have a good understanding of the program and market issues are not well understood.

Without modifications, the PA Nutrient Trading Program is unlikely to be viable as a long-term option for would-be market participants given the structural issues, transactional costs, apparent barriers, and need for additional outreach and education. For the most part, present circumstances inhibit the development of willing buyers (demand) for credits currently available in the market place. The PANTP may work for a limited number of traders over the short-term, but long-term substantial participation does not appear to be likely in the present configuration of PANTP. Without careful study of structural issues and barriers, followed by structural changes to the program and accompanied by a concerted education and outreach effort, this is unlikely to change.

Potential Sources of Financial Support

Cumulatively, Maryland and Virginia have committed over $1.6 billion to help their municipal wastewater treatment plants meet Clean Water Act mandates. Unlike Virginia and Maryland, Pennsylvania does not have a dedicated fund for financing of nutrient-related upgrades. Because Pennsylvania does not have a funding source dedicated for installing nutrient removal technology at municipal wastewater treatment plants and because the two funding sources commonly used, PENNVEST and Growing Greener, do not have internal funds dedicated specifically for this purpose, information about the amount of funds Pennsylvania has committed to nutrient removal at municipal wastewater treatment plants is not readily available.

However, for the FY09 Pennsylvania budget, the legislature and Governor approved new statewide water infrastructure funding that offers $800 million in grants for water-related projects, and an additional $400 million for grants and loans (with no more than one-half of the $400 million as grants in the aggregate) if a bond issue referendum is approved in November 2008. The $800 million program includes dam upgrades and flood control, specifically earmarking $135 million to such projects. For water and sewer projects, grants are limited to two-thirds of the project cost. At least 50% of the grants for water and sewer projects are reserved for projects that consolidate systems or are already regional. Priority is to be given to applicants subject to a court order/consent decree, or new permit requirements imposed after January 1, 2007; i.e., nutrient removal upgrades. Funding for the purchase of nutrient credit is expressly prohibited. With respect to the $400 million, if approved by the voters, funding will be more focused, being limited to water and sewer projects, and allows the use of funds for nutrient credit purchases.

Looking Ahead

The making of definitive recommendations that are properly researched and well-grounded is beyond the purview of this study. However, the findings of the study lend themselves to some implications for the future, which are offered herein as guidance to the appointed architects of legislative initiatives and program reform as they study and shape revisions.

- The $1.4 billion in nutrient removal-related capital requirements ($2.0 billion overall) is currently underfunded, in spite of substantial strides taken in recent months.
- Nutrient trading and other alternatives to capital improvements are already factored into 2010 planning.
- Changes to the nutrient trading program will need to focus on –
  - Assuring long-term availability and firm pricing of credits
  - Encouraging participation by smaller Phase II and Phase III Dischargers, which generally have a greater incentive to utilize credits and more time to act.
  - Enhanced education and outreach,

2.0 BACKGROUND

In the late 1970s, the United States Congress funded a study to analyze the decline in living resources of the Chesapeake Bay. The study identified an oversupply of nutrients as the main source of the Bay's degradation. After the publication of these initial findings, the Chesapeake Bay Program was established in 1983 as a regional partnership whose mission is to lead and direct the restoration of the Chesapeake Bay. The executive body of the Chesapeake Bay Program is the Chesapeake Executive Council, which establishes the policy direction of the program and consists of the Governors of Maryland, Pennsylvania, and Virginia, the Administrator of the United States Environmental Protection Agency, the Mayor of the District of Columbia, and the Chair of the Chesapeake Bay Commission.

Since its creation, the Chesapeake Bay Program has been primarily focused on reducing the amount of nutrients and sediment entering the Bay. More recently, the Chesapeake 2000 Agreement reaffirmed the commitment of the Chesapeake Bay Program to restoration and protection of the Chesapeake Bay by establishing several goals, one of which was to remove the Bay from the federal Clean Water Act’s list of impaired waters prior to 2010 (and thereby staving off a federally mandated total maximum daily load) by addressing nutrient- and sediment-related problems. The Chesapeake 2000 Agreement committed the state partners to develop specific plans, referred to as Tributary Strategies or Tributary Compliance Plans, designed to reduce nutrient and suspended-sediment loadings to acceptable levels (Cap Loads) in each of the tributaries throughout the watershed.

The Pennsylvania Department of Environmental Protection (DEP) issued the Chesapeake Bay Tributary Strategy (CBTS) in 2005 to address Pennsylvania’s commitment to nutrient and sediment reductions in the Chesapeake 2000 Agreement. According to the 2005 CBTS, the Commonwealth’s 183 significant municipal dischargers contribute approximately 11% percent of the nitrogen load to the Bay from Pennsylvania each year. In contrast, Maryland’s 66 significant STPs contribute 26% of their total nitrogen load while in Virginia’s 125 plants represent 29% of their total nitrogen load. Consequently, a portion of the Chesapeake Bay Tributary Strategy focuses on nutrient and sediment reductions to be achieved by point source dischargers, the majority of which are municipally owned and operated wastewater treatment plants in the Susquehanna and Potomac River Basins of Pennsylvania. With respect to municipal point source dischargers, as it was first issued, the CBTS established effluent nutrient load limitations based on 8.0 mg/L total nitrogen (TN) and 1.0 mg/L total phosphorus (TP) at each discharger’s projected 2010 flow. In response to concerns from dischargers, an alternative proposal for nutrient load limitations was issued for public comment in 2006. The alternate proposal detailed a rationale for establishing effluent nutrient load limitations based on 6.0 mg/L TN and 0.8 mg/L TP at each discharger’s design annual average flow on August 29, 2005. Based on a significant majority of positive responses (92%) to the alternate proposal, DEP decided in July 2006 to implement the alternate nutrient load limit allocation method to meet the objectives of the CBTS.

The amended CBTS deploys the revised effluent load limitations for significant municipal point source dischargers (i.e., dischargers equal to or greater than 0.4 mgd design annual average flow on August 29, 2005) over a phased implementation schedule. Effluent load limitations under the CBTS will become effective for Phase 1, 2, and 3 dischargers on October 1 of 2010, 2012, and 2013, respectively. The list of Phase 1, 2, and 3 dischargers per as defined by DEP’s Alternate Allocation Strategy is attached as Appendix A. Although not included in the pending nutrient load limitations, CBTS makes provisions for municipal point source dischargers less than 0.4 mgd as well as industrial point source dischargers as part of future amendments to the CBTS.

Policy makers, regulatory officials, municipal executives, and wastewater treatment professionals recognize that a reduction in nutrient load from dischargers will benefit the Chesapeake Bay and that widespread wastewater treatment facility upgrades will be a significant contributor to achieving the effluent nutrient loads limitations targeted by the Chesapeake Bay Tributary Strategy. However, there has been differing opinions on the cost impact of CBTS compliance on municipal point source dischargers. Estimates have ranged from as low as $190 million to $1 billion or more. Also, amendments to the CBTS included provisions for a nutrient credit trading program, with the intent being that the nutrient credit trading program could serve as a more cost-effective alternative to wastewater treatment facility upgrades for dischargers seeking CBTS compliance. As of early 2008, dischargers did not appear to be using the nutrient credit trading program at the rate originally anticipated by DEP.

In response to concerns from municipalities and municipal authorities within their districts facing the financial impacts of the Chesapeake Bay Tributary Strategy compliance, a group of Pennsylvania State Senators introduced and adopted Senate Resolution No. 224 of the Session of 2008 (SR 224), which directs the Legislative Budget and Finance Committee (LBFC) to study the cost for municipal point source dischargers to comply with CBTS. Specifically, SR 224 requires the LBFC to:

1. Estimate the costs that dischargers will incur to comply with CBTS

2. Assess the methods by which dischargers may achieve CBTS compliance, including physical treatment facility improvements as well as alternatives such as nutrient credits

3. Identify financial resources available to dischargers in Pennsylvania seeking CBTS compliance, as well as financial resources that other states in the Chesapeake Bay watershed have committed to assist wastewater treatment plants in achieving compliance with applicable effluent limitations

4. Report findings and conclusions of the study by November 12, 2008, which corresponds to nine months from the February 12, 2008, adoption of SR 224

Due to the time constraints of SR 224 and technical knowledge and expertise required to assess wastewater treatment facility improvements, LBFC retained the services of Metcalf&Eddy|AECOM (M&E) to assist in the completion of the directives of SR 224. M&E's scope of work was to complete above item numbers 1, 2, and 4, with the LBFC staff to complete item number 3 above. M&E engaged two subconsultants to support fulfilling this scope of work. In support of the first task, the Pennsylvania State University Statistical Consulting Center (PSU-SCC) provided a statistical review and confidence limits to the estimated cost of compliance. As a major part of Task 2, Material Matters, Inc. prepared the nutrient trading assessment.

3.0 OBJECTIVES AND APPROACH

The objective of the CBTS Compliance Cost Study is to provide the Legislative Budget and Finance Committee with the technical information and analysis needed to complete the directives of SR 224.

M&E's role in completion of this objective was to survey the 183 "significant" (i.e. Phase 1, 2, or 3) treatment facilities in a timely manner and gather validated information on nutrient removal upgrade capital costs and the potential role of nutrient trading and other options in mitigating those costs. LBFC staff's role in completion of this objective was to identify financial resources available to dischargers in Pennsylvania seeking CBTS compliance, as well as financial resources that other states in the Chesapeake Bay watershed have committed to assist wastewater treatment plants in achieving compliance with applicable effluent limitations. Together, this information will enable the legislature to make informed, sound decisions on financial need and potential financial assistance.

The overall approach for the study was defined in the LBFC's request for proposals, and is summarized by the following phases and tasks:

- **Cost Data Collection**

  In this Phase, M&E developed a survey to gather detailed information desired by the LBFC in each of the categories:

  - Description of the discharger's existing facility
  - Consideration of alternatives such as nutrient trading
  - Planned facility improvements, if applicable, for achieving TN and TP cap loads
  - Status of the discharger's facility improvements
  - Costs of facility improvements

  M&E initially distributed the survey to the dischargers via email for rapid dissemination. Dischargers that could not be reached by email were contacted and sent surveys via fax or postal mail. To facilitate responses, M&E made follow up phone calls and sent email reminders. M&E also communicated with local engineering consultants to make other professionals and their respective clients aware of the survey.

  Responses to the survey were compiled by M&E into a database for LBFC's use. The raw survey responses have been copied onto a CD. The survey is attached as Appendix B, and database and raw responses are attached as Appendix C. The survey, response rates, and application of survey responses will be discussed in greater detail in subsequent sections of the report.

- **Cost Data Validation**

  In order to review and verify information provided by the dischargers and to gain a more intimate understanding of the challenges dischargers face in achieving CBTS compliance, M&E conducted site visits to a representative sample of dischargers. The following considerations were made in selection of the representative sample of dischargers that received site visits:

  - Visit dischargers whose reported costs appear to be "outliers"
  - Visit dischargers of varying capacity
  - Visit dischargers across Phases 1 – 3

- Visit dischargers utilizing different types of treatment technology
- Visit dischargers in different locations within the CB watershed

Findings of the site visits were used to refine the nutrient related capital cost estimate for the body of significant dischargers. The findings of the site visits are discussed in Section 6.

- **Cost Data Analysis**

  Using the costs of CBTS compliance reported by dischargers in survey responses, and using insights gained through data validation efforts, M&E developed a cost equation that was used to estimate costs for dischargers that had not responded to the survey (or did not report costs in their survey response) for the entire body of significant dischargers. The cost estimate for the entire body of significant dischargers was calculated by adding the estimated costs (using the cost equation) to reported costs (from survey responses). All costs were indexed to 2009 dollars. The cost data analysis resulted in the following estimates of interest to LBFC:

  - Total capital cost including costs not related to nutrient removal
  - Capital cost pertaining specifically to nutrient removal and CBTS compliance
  - Ranges for each estimate, taking into consideration the accuracy of the reported cost data that was used to develop the cost equation.

- **Evaluation of Dischargers' Consideration of Nutrient Credits and Other Alternatives**

  As part of the survey, M&E asked questions to evaluate the degree of consideration that dischargers had given to alternative approaches to facility upgrades in order to achieve CBTS compliance. In parallel with the survey and cost estimating phases, in conjunction with our subconsultant, Material Matters, Inc., a detailed evaluation of the nutrient credit trading program was conducted. as part of the study. Section 9 reports the degree to which respondents considered alternative approaches, and Section 10 provides and evaluation of the nutrient trading program as currently constituted.

- **Identification of Financial Resources**

  LBFC staff researched and reported financial resources currently available to dischargers located in Pennsylvania and subject to CBTS, as well as the resources that other states in the Chesapeake Bay Watershed have committed to assist dischargers achieve compliance with applicable standards. The LBFC staff's findings are documented in Section 11 of this report.

4.0 SURVEY AND RESPONSES

The "Alternate Allocation Strategy Table" from DEP Chesapeake Bay Steering Committee's Alternative Wasteload Allocation Proposal dated June 28, 2006 served as the list of significant dischargers to be surveyed as part of this study. The table is attached as Appendix A for reference. As discussed later, the table was also an important reference used in cost estimating.

The LBFC specified detailed information for M&E to obtain as part of the survey. The survey was designed by M&E to obtain this specified information, as well as other pertinent information that would be useful in data analysis. Although it was detailed and comprehensive, the survey was designed to be user friendly and clearly worded. In an effort to facilitate as many responses as possible, the survey was structured to direct the respondents to report “key information” and only report other more detailed information if it was readily available. After internal and external “beta-testing” and consensus building with LBFC staff, representatives of DEP, and representatives of Pennsylvania Municipal Authorities Association, the survey was released to the dischargers. A blank copy of the survey form is attached as Appendix B.

In its request for proposals, the LBFC had set goals for response rates of 90% response from the 63 Phase 1 dischargers and 25% of the remaining significant dischargers (i.e. Phase 2 and 3 dischargers). M&E proactively strove to meet these goals by calling and emailing dischargers, contacting engineering consultants in the region, and promoting the survey through organizations related to the municipal wastewater treatment industry (such as PWEA and PMAA) and at related meetings (such as PENNTEC). Through these efforts, M&E received 42 responses from Phase 1 dischargers (a 67% response rate) and 39 responses from Phase 2 and 3 dischargers (a 33% response rate). It is worth noting that for the Phase 1 respondents, all dischargers greater than 10 mgd average design capacity responded to the survey. Consequently, the response rate based on design flow of the Phase 1 respondents to total design flow of all Phase 1 dischargers was 77%. These results are summarized in Table 4-1.

Table 4-1
Summary of Survey Response Rates

	Phase 1	Phase 2 and 3
Number of dischargers[1]	63	120
Number of responses	42	39
Response rate	67% (based on number of responses) 77% (based on design flow)	33%
Response rate goal	90%	25%
Comments	Below goal number of responses, but satisfactory for cost equation confidence limits	Goal met

1. Based on 6/28/06 Alternate Allocation Strategy Table

Although the response rate from Phase 1 dischargers was short of the goal set by LBFC, the overall body of responses obtained was adequate for purposes of generating an equation to estimate costs for non-responders. Figure 4.1 demonstrates this by presenting a graph of the number of responders vs. non-responders for the following flow categories based on design average flow in August 2005:

- 0.4 – 1 mgd
- 1 – 3 mgd
- 3 – 10 mgd
- >10 mgd

Figure 4.1 shows that, as would be reasonably expected, plants with a lower capacity (predominantly part of Phase II and III and thus not as far along in planning, design, and construction of facility improvements) had a lower response rate. However, for this large group of smaller facilities, enough responses were received in absolute terms to estimate costs for non-responders with high confidence. Response rate increased with plant capacity, and thus the need to estimate costs decreased. Plants greater that 10 mgd had a 100% response rate, which is significant because costs for these key plants did not need to be estimated using the cost equation. Direct survey responses were used.

Because the survey was structured to serve as a tool for estimating capital costs for "nutrient removal only" as well as total facility upgrade capital cost, careful guidelines were given to respondents in survey question D4, where respondents were asked to report costs for "nutrient removal only" versus overall project cost, along with an itemization of improvements contributing to the costs driven by nutrient cap loads. Most respondents gave detailed responses to this question or attached a cost estimate or other cost breakdown for reference. Because the cost estimates that were generated for the entire body of discharges were to be indexed to 2009 dollars, survey questions D6 and D7 allowed the respondent to complete the survey using readily available information, but also gave M&E a reference date associated with the reported cost whereby 2009 dollar amounts could be indexed. Indexing approach is discussed later in Section 5. The survey was also structured to capture the actual or projected change in operations and maintenance cost through questions D15 – D17. Operations and maintenance costs are discussed later in Section 7.

In survey question B16, the dischargers were asked to report the status of facility improvements for achieving TN and TP cap loads. Beyond its face value in allowing the LBFC to know where dischargers stand in terms of planning for, designing, or constructing facility improvements, this question was important because responses to this question have implications as to the degree of uncertainty (or certainty) of the reported cost information. For example, the cost information reported by a facility that is at the conceptual design stage has a high degree of uncertainty, whereas the cost information reported by a facility that has completed construction has no uncertainty.

Figure 4.2 presents a summary of the responses to survey question B16, and shows that a significant majority of respondents were somewhere in-between the stages of initial facility planning and preliminary design, where less detailed but reasonable "budget estimate" order of magnitude costs would be expected. M&E would expect that cost estimates associated responses "6 - Conceptual design is complete" and "5 – Preliminary design" to be analogous "budget estimates" per ANSI Standard Reference Z94.2-1989 (Industrial Engineering Terminology: Cost Engineering). The accuracy range for "budget estimates" is typically -15% to +30%. M&E would expect that cost estimates associated with response "4 – Final design" would be analogous to "definitive estimates" per ANSI Z94.2-1989. The accuracy range for "definitive estimates" is typically -5% to +15%. Neglecting change orders, the accuracy range for costs associated with reponses "3 – Construction contract awarded" and "2 - Improvements have been constructed or are currently under construction" would be ±0%. Reported cost estimates that may ultimately be proven to be high or low should cancel out when applied to the entire body of dischargers

Responses to survey questions D8 (detailed construction cost breakdown into materials, labor, equipment, etc.) and D9 through D14 (construction financing costs) were limited, consistent with the majority of reported data having only reached the planning-level stage.

The compiled survey database and original responses from each respondent have been copied onto the CD that is attached as Appendix C.

Fig. 4.1
Response Rates by Flow Group

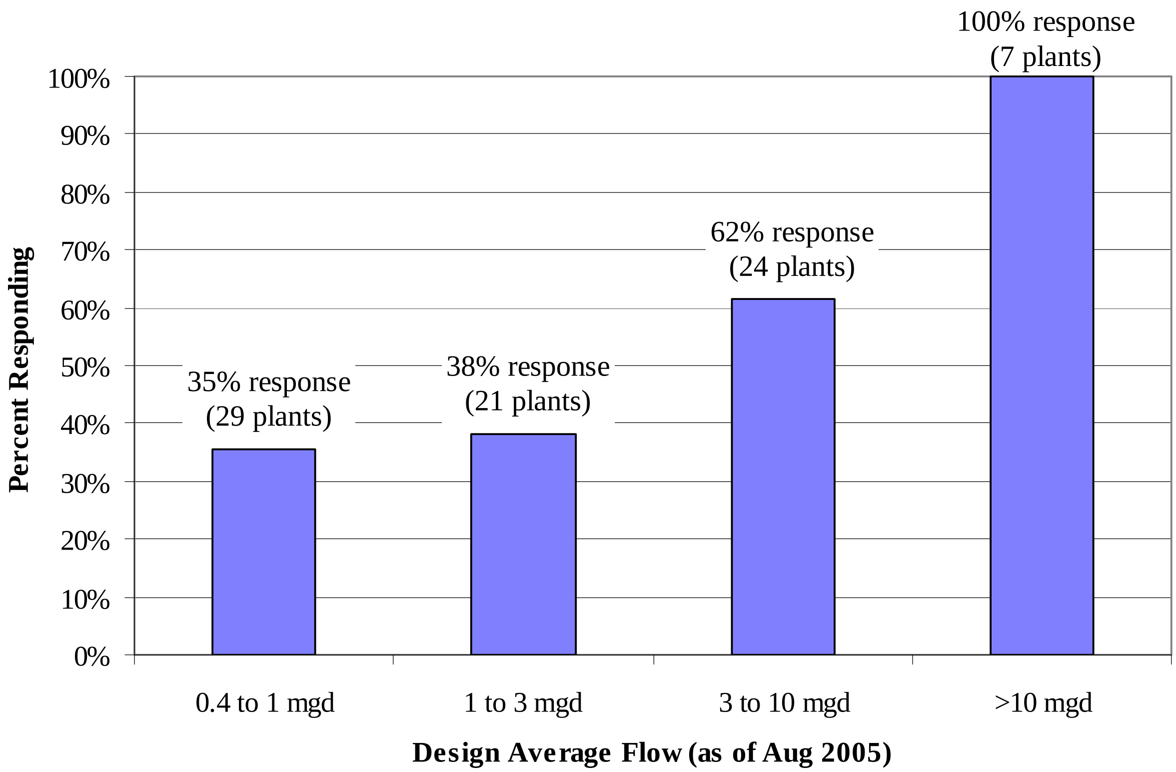
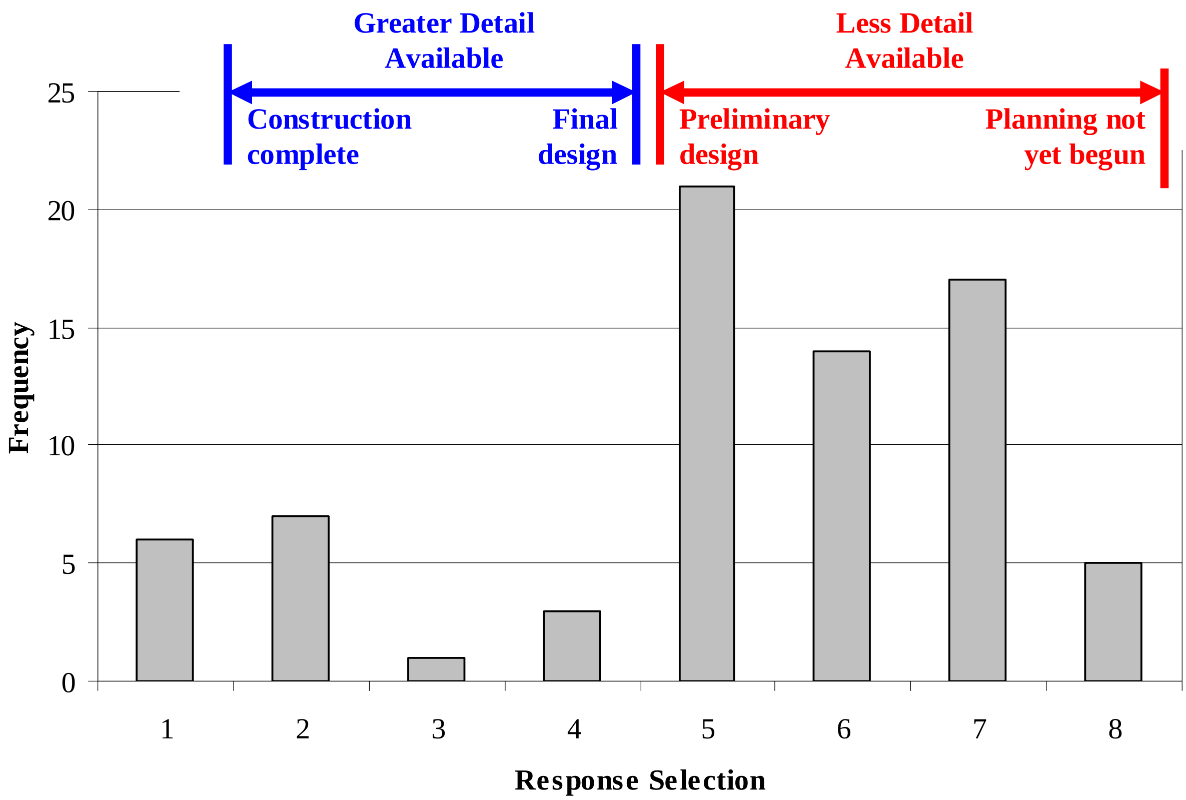


Fig. 4.2
Responses to Survey Question B16 (Status of Facility Improvements).



Response Selection Legend
1. Improvements were not required. Facility already met designated cap loads prior to CBTS.
2. Improvements have been constructed or are currently under construction.
3. Construction contract has been awarded but construction has not started.
4. Final design is completed; construction has not yet begun.
5. Preliminary design is underway or has been completed.
6. Conceptual design is complete. A concept has been selected, but design has not yet begun.
7. Initial facility planning and evaluation of options is underway, but not yet complete.
8. Initial facility planning has not yet begun.

5.0 CAPITAL COST ANALYSIS AND INITIAL ESTIMATES

For the body of significant dischargers, M&E estimated the total capital cost (including costs not related to nutrient removal) and capital cost pertaining specifically to nutrient removal and CBTS compliance. Both of these estimates are of interest to LBFC and the State. Total capital cost may be relevant to the Sewage Management and Treatment Task Force (created by House Resolution 2005-8), the Sustainable Water Infrastructure Task Force (established by Executive Order 2008-02), and the Pennsylvania Infrastructure Investment Authority (PENNVEST). Nutrient removal capital cost may be of interest to these organizations as well as the legislature with respect to making decisions on financial need and potential financial assistance to municipal wastewater dischargers.

Three capital cost categories influenced estimation of nutrient-related capital cost and total capital cost. These categories are:

- Nutrient-related construction cost – Cost for nutrient removal treatment process improvements as well as "other related improvements" required for nutrient removal functionality. This cost was requested in survey question D4a.

- Total project construction cost – Cost for the construction of the overall project that includes nutrient removal improvements as well non-related improvements. This cost was requested in survey question D4c.

- Capital costs (excluding construction) – These costs include planning, design, and land acquisition for planned upgrades and were requested in survey question D1a, D2a, and D3a, respectively. For nutrient-related capital cost estimates, the portion of capital costs (excluding construction) associated with nutrient removal was assumed to be proportionate to the ratio of nutrient-related construction cost to total project construction cost.

To facilitate ease of response for survey respondents, the survey was structured to accommodate the reporting of capital costs in terms of past, present, or future values. This enabled M&E to index reported costs to 2009 dollars as requested by LBFC.

In the first step to bringing reported costs to 2009 dollars, M&E indexed reported costs to present dollars. Cost reported as being based on past dollars was indexed to present using ENR historical cost indices. Costs reported as being based on July 2008 coincided with "present" and did not need to be indexed. Also, if the respondent did not indicate the date on which costs were based, it was assumed to be in present dollars. Costs reported as being based on projected dollars were de-projected based on the respondent's reported projection assumptions and then indexed to present using ENR cost indices.

In the second step to bringing reported costs to 2009 dollars, M&E took the indexed present dollar cost for each respondent and escalated it from July 2008 to January 2009 at five percent (5%) per year. Five percent was selected as annual escalation based on the increase in the ENR index from January 2008 to July 2008. The resultant escalation factor was a 2.5% increase of the present cost calculated in the first step.

Figure 5.1 presents a plot of respondents' reported nutrient-related capital cost, indexed to 2009 dollars using the approach described above, versus design average flow on August 29, 2005. As would be expected for wastewater plants, there is a high degree of variation in indexed cost due to the different existing treatment processes used at plants and different approaches to nutrient removal selected by dischargers. Note that, as expected for the group of Pennsylvania dischargers, most respondents fall below 10 mgd design capacity. To better view the cost vs. capacity pattern for typical discharger capacities, and because all dischargers greater than 10 mgd capacity reported the estimated cost of nutrient removal upgrades, the cost vs. capacity was plotted for plants less than 10 mgd. This graph is presented as Figure 5.2.

Figure 5.1

Reported Nutrient-Related Capital Cost vs. Design Average Flow on August 29, 2005 (for all respondents)

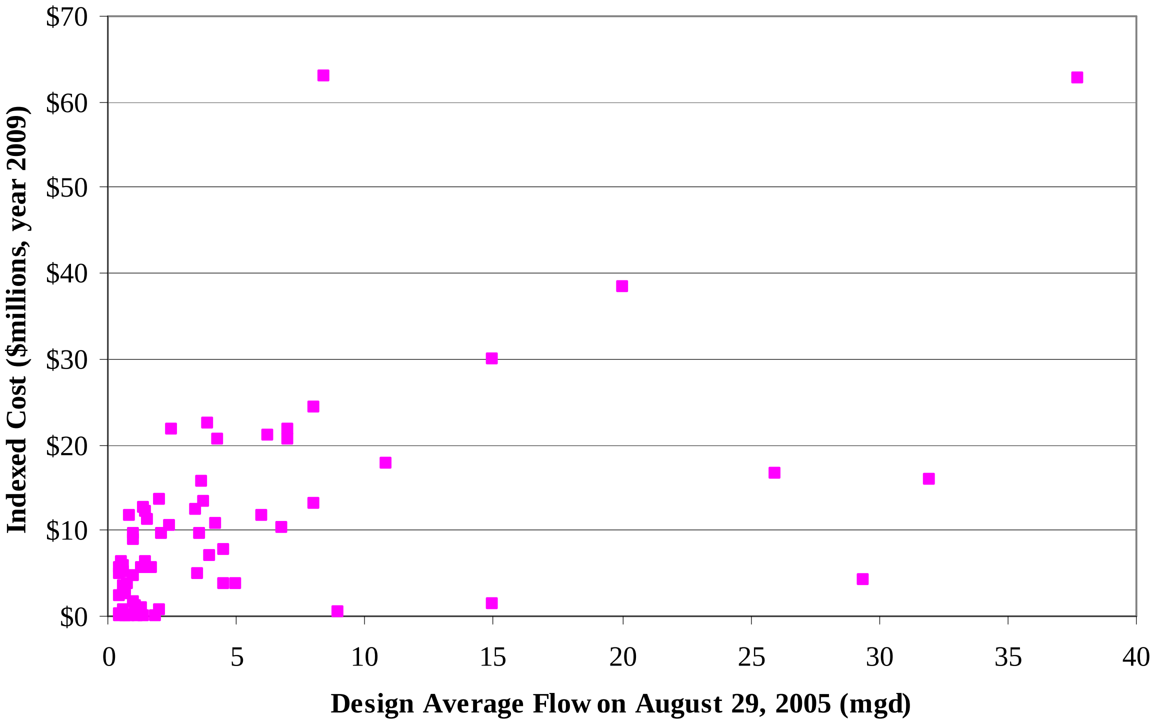


Figure 5.2

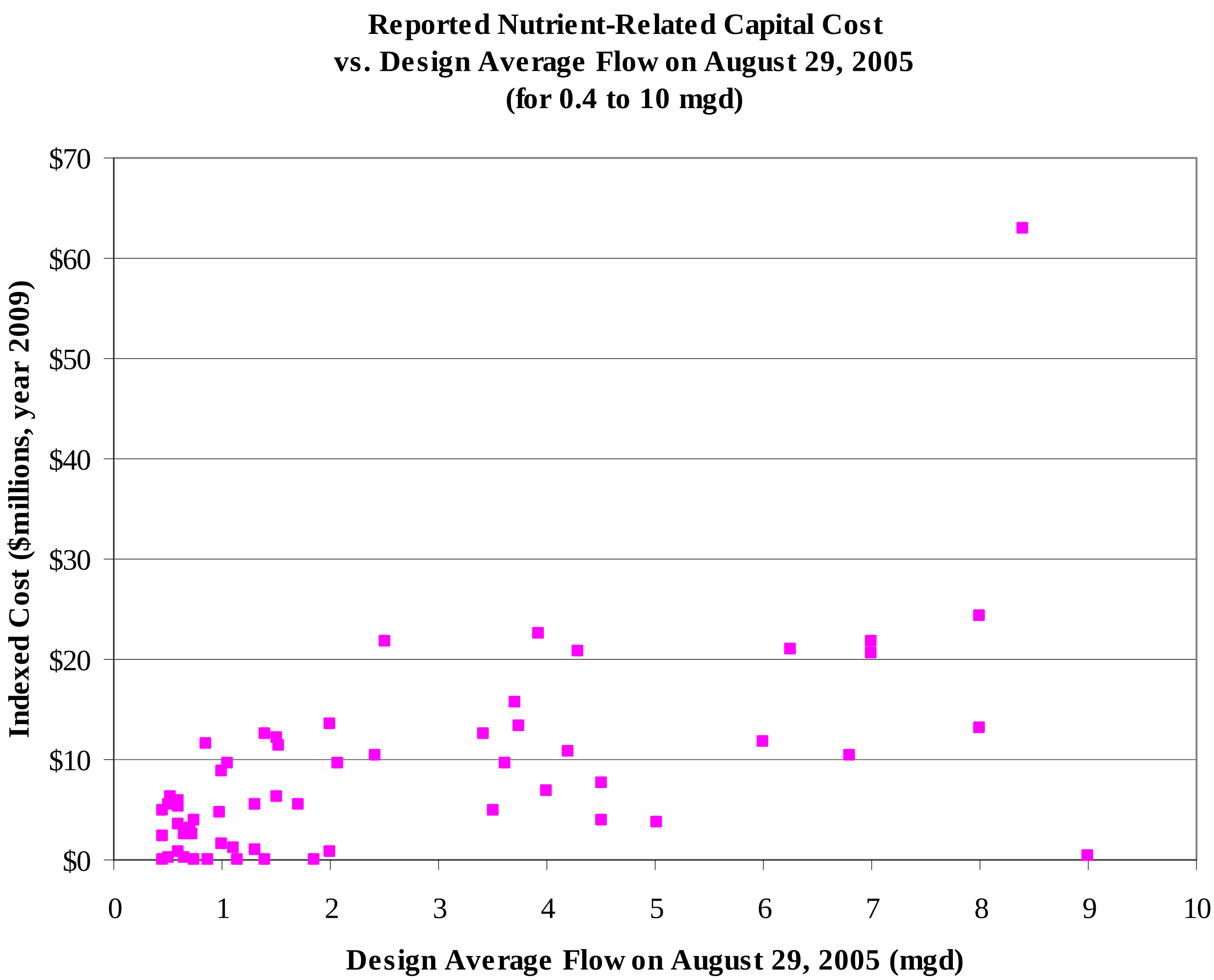


Figure 5.2 shows the reported 2009-indexed nutrient-related capital cost versus design average flow for respondents whose design average flow in August 2005 was less than 10 mgd. This data set served as the basis for cost curve regression because all plants greater than 10 mgd responded to the survey. The regression was based on 2005 design average flow because the majority of dischargers favor the alternate allocation strategy of nutrient cap loads based on 6 mg/L TN and 0.8 mg/L TP at their 2005 design average flow.

M&E retained the services of the Pennsylvania State University Statistical Consulting Center (PSU-SCC) to perform regression, statistical analysis, and provide an estimate of nutrient-related capital costs with a defined confidence interval. PSU-SCC's report is attached as Appendix J. The key findings are summarized in the following paragraphs.

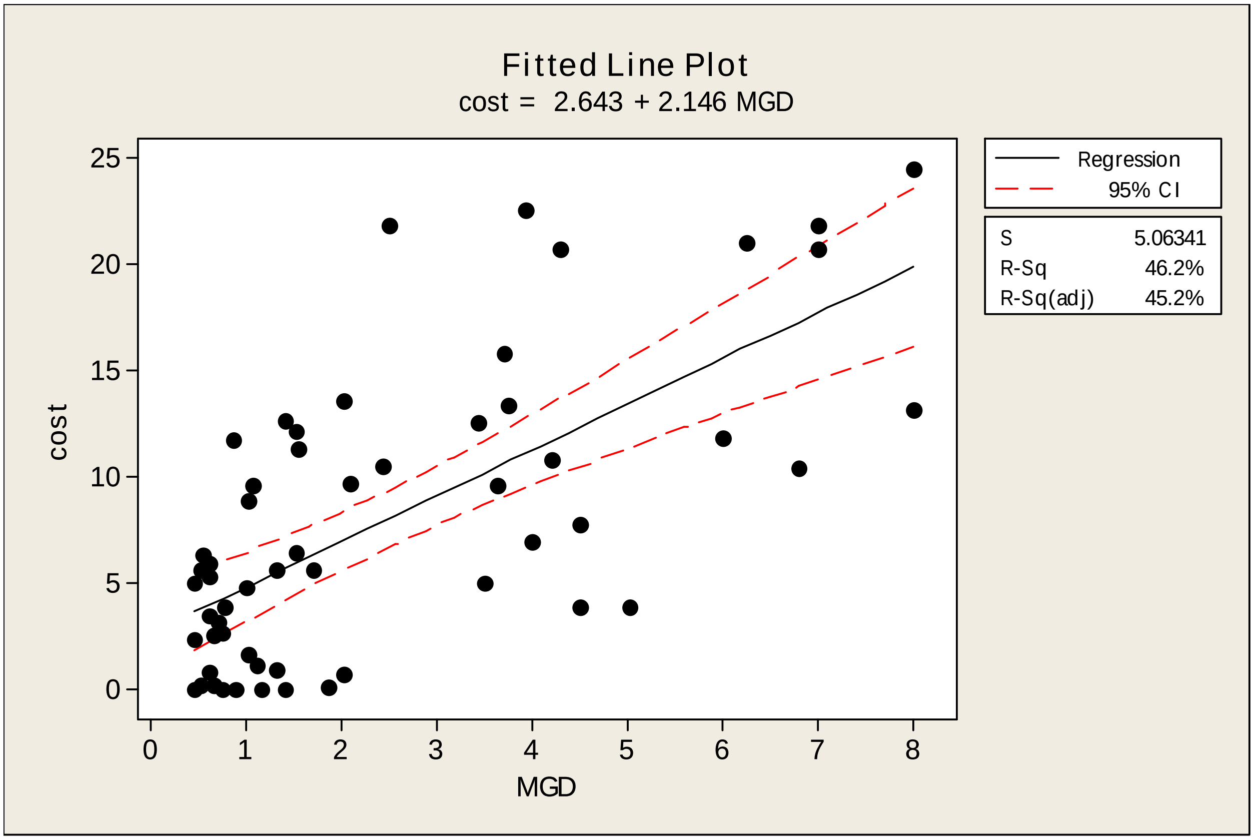
PSU-SCC performed a regression of the reported 2009-indexed nutrient-related capital costs for plants less than 10 mgd design average flow (i.e. the data set embodied by Figure 5.2). As Figure 5.2 shows, the regression included zero-cost plants whose existing plant processes already removed nutrients prior to

CBTS. Data points (9.00 mgd, $0.42M) and (8.40 mgd, $62.96M) were omitted from the data set to achieve a better regression. The resultant predictive cost equation for non-responding dischargers less than 10 mgd average design flow was:

Predicted Nutrient-Related Capital Cost, in millions = 2.643 + 2.146(MGD)

Figure 5.3 shows a plot of the regression and cost equation by PSU-SCC.

Figure 5.3
Regression and Cost Equation (applicable to plants less than 10 mgd average design flow)



Estimation of the 2009-indexed nutrient-related capital cost for the entire body of dischargers consisted of three basic steps. In the first step, the indexed reported costs for respondents were summated. In the second step, the linear cost equation was used to estimate costs for non-respondents, and the estimated costs for the non-respondents were summated. Finally, the estimate for the entire body of dischargers was calculated as the summation of reported costs plus the summation of estimated costs. The resultant initial estimate of the 2009-indexed nutrient-related capital costs for the entire body of dischargers was $1.43 billion ± $0.14 billion at the 95% confidence interval. As will be discussed in Section 7, this initial estimate was later revised based on findings of site visits.

The nutrient-related capital cost estimate of $1.43 billion (with implied confidence interval) includes plants that reported cost for upgrades that have been completed. To determine the estimated nutrient-related funding need, the 2009-indexed costs for dischargers whose upgrades were summated; this total

$44 million). Comparing the completed upgrades ($44 million) to the total nutrient-related capital cost estimate ($1.43 billion) on a capital cost basis, three percent of the upgrades have been completed. Therefore, 97% of the nutrient-related estimate represents a potential nutrient-related funding need.

Because the focus of this study was estimating nutrient-related cost, the overall project capital cost (i.e., cost including items not related to nutrient removal) did not receive the same regression and estimation treatment. Total capital cost for the body of dischargers was estimated using the average of the reported ratio of nutrient-related construction cost (survey question D4a) to overall project construction cost (survey question D4c). From the data set of survey responses, the average nutrient-to-overall project construction cost ratio was 0.73, or 73%. Applying this ratio to the initial nutrient-related funding need estimate of $1.43 billion as determined above, the estimated overall capital cost for upgrades to plants operated by the body of dischargers is $1.96 billion in 2009-indexed dollars.

6.0 SITE VISITS AND REFINEMENT OF NUTRIENT-RELATED CAPITAL COST ESTIMATE

In order to review and verify information provided by the dischargers and to gain a better understanding of the challenges dischargers face in achieving CBTS compliance, M&E conducted site visits to a representative sample of dischargers. The following considerations were made in selection of the representative sample of dischargers that received site visits:

- Visit dischargers whose reported costs appear to be outliers
- Visit dischargers of varying capacity
- Visit dischargers across Phases 1 – 3
- Visit dischargers utilizing different types of treatment technology
- Visit dischargers in different locations within the CB watershed

Due to sensitivity to information shared by dischargers selected for site visits, the sites are not identified by name in the body of the report. Site visit memoranda are attached as Appendix D. However, the following characteristics demonstrate the variety of plants chosen for the representative sample:

<u>Plants visited, by Phase:</u>

Phase 1 – 9 plants
Phases 2 and 3 – 11 plants

<u>Design flow (mgd, in August 2005) of plants visited, in order of decreasing capacity:</u>

29.37
8.00
7.00
6.80
6.25
4.29
3.50
2.42
1.85
1.70
1.53

1.05
0.75
0.70
0.65
0.60
0.50
0.45
0.45
0.40

Existing (or former, in case of upgraded plants) process of plants visited, in alphabetical order:

Aerated facultative lagoon
Contact stabilization & nitrification
Contact stab. & extended air hybrid
Conventional activated sludge – 5 plants
Extended aeration – 2 plants
Mechanical aeration – 3
Oxygen activated sludge with BNR
Sequencing batch reactor – 2 plants
Trickling filter – 2 plants
Trickling filters & nitrification tanks
Vertical loop reactor

Location (county) of plants visited, in alphabetical order:

Blair
Columbia
Franklin – 2 plants
Lackawanna – 2 plants
Lancaster – 3 plants
Lebanon – 3 plants
Luzerne
Lycoming
Mifflin
Union
York – 4 plants

A key objective of the site visits was to verify the reasonableness of the reported nutrient-removal related construction costs. Although many of the plants selected for site visits appeared as outliers on paper, most site visits revealed that the reported construction cost and the division of nutrient-related cost versus overall cost were reasonable based on plant circumstances and nutrient removal design approach. Several dischargers selected for site visits provided a detailed cost estimate breakdown which facilitated the verification of nutrient-removal related costs. Of the 20 plants visited, for 14 of the plants it was concluded that reported costs were reasonable "as reported". Nutrient-related construction costs were reduced for three plants, and increased for two plants. One plant, although reporting estimated construction costs, indicated it will purchase nutrient credits prior to its cap loads going into effect. When averaging the recommended adjustments to nutrient-related cost across the 20 sites, the average adjustment was a two percent (2%) decrease.

Applying the 2% decrease to the initial nutrient-related capital cost estimate in Section 5, the refined 2009-indexed nutrient-related capital cost estimate is $1.40 billion. It is assumed that the 95% confidence interval (±0.14 billion) is not significantly changed by this refinement. The overall project capital cost estimate is not impacted by this refinement to nutrient-related capital cost; the refinement simply re-categorizes the "2% portion" from nutrient-related capital cost to overall project capital cost.

Other insights from the site visits include:

- Some dischargers expressed concern that if upgrades are designed and constructed to meet CBTS cap loads, that new limits imposed shortly after construction will require a second phase of upgrades. Also, some dischargers either currently have or anticipate near-term issuance of TMDL requirements that are more stringent than CBTS annual cap loads. For these reasons, some dischargers are upgrading their plants to meet limits lower than those associated with CBTS annual cap loads. Also, for some dischargers, the uncertainty of a defined effluent limit has been a factor in delaying upgrades until the controlling effluent standard is determined.

- Some dischargers expressed concern that an influx of treatment plant upgrade projects may shift the bidding climate in favor of contractors, and that upgrade projects may come in over budget.

- Many dischargers expressed concern over the long-term cost, reliability, and availability of nutrient credits. Some dischargers do not have the option to use nutrient credit trading because they are required to meet a TMDL requirement. Nutrient credit trading is discussed in greater detail in Section 10.

7.0 OPERATIONS COST ANALYSIS

Depending on the existing treatment process and the processes selected for nutrient removal upgrades, operation and maintenance (O&M) costs may be impacted by the following:

- Staffing needs
- Alkalinity addition to nitrifying systems
- Carbon addition to denitrifying systems
- Chemical addition for precipitation of phosphorus
- Polymer addition for processing additional sludge
- Sludge hauling and disposal costs
- Energy costs for aeration, mixing, and pumping systems
- Maintenance costs associated with new equipment

Respondents had the opportunity to report current annual O&M costs projected annual O&M costs after nutrient removal upgrades in survey questions D15 and D16. Respondents could also report projected O&M costs in terms of percent increase in survey question D17.

In cost analysis, M&E calculated the reported change in O&M costs for each discharger that provided a response to the above referenced questions. Because of the number of variables going into each discharger's O&M cost projections, M&E averaged the reported change in O&M costs for groups of increasing design flow. The results are presented in Table 7-1.

Table 7-1
Reported Increase in Annual O&M Cost per Facility, by Flow Groups

Design Average Flow (mgd, on August 29, 2005)	Increase in Annual O&M Cost per Facility ($ millions)
0.4 – 1	$0.16
1 – 3	$0.29
3 – 5	$0.45
5 – 10	$0.63
>10	$1.69

Based on recent projects where M&E estimated O&M cost changes due to nutrient removal upgrades, the average reported increase in O&M cost for the flow groups appear reasonable. Applying the average increase in annual O&M cost to the body of significant dischargers, the total estimated annual O&M increase is $61 million per year.

8.0 USER RATE COST ANALYSIS

Dischargers had the opportunity to report their current residential user rate schedule and the actual or projected rate increase associated with completed or planned upgrades. Responses ranged from no increase (for those plants already meeting nutrient removal requirements) to three hundred percent (300%) increase in user rates. The average reported rate increase was 48%.

Because reported rate increases are a function of current user rates, it is difficult to draw conclusions based on reported rate increases. Certainly, any significant upgrade project, largely driven by nutrient cap loads, will have an impact on rates. However, if user rates have not been increased for a long duration, the reported rate increases (in percentage) will be skewed high.

Therefore, M&E sought an alternate approach to quantifying cost impacts on a “user” basis. The 2009-indexed nutrient-related capital cost of $1.40 billion (from Section 6) was calculated on a “per-household-equivalent” (HHE) basis using the following approach and assumptions:

- From the 2000 Census, the average household size in PA was 2.48 capita
- Using references for typical wastewater generated per capita, based on a household size of 2.48, 70 gallons of wastewater per capita are typically generated per day
- Defining one HHE as 2.48 capita, one HHE equals 175 gpd of wastewater
- Using the estimated 2010 total flow of 384 mgd as an approximation for current flow discharged by the 183 dischargers in Phase 1 – 3 as shown in Appendix A, there is currently approximately 2.19 million HHE of wastewater discharged by the group of “significant dischargers” calculated as follows:

  $(384 \times 10^6 \text{ gpd})\ (1 \text{ HHE} / 175 \text{ gpd})(1 \text{ million HHE} / 10^6 \text{ HHE}) = 2.19 \text{ million HHE}$
- Dividing the 2009-indexed nutrient-related capital cost of $1.40 billion by 2.19 million HHE gives an estimated 2009-indexed cost of approximately $639 per HHE. To convert this to an annual debt service figure, typical PENNVEST rates were used. On this basis, the $639/HHE

capital cost becomes $40/HHE/yr annualized 2009-indexed nutrient-related capital cost capital cost.

- Similarly, dividing the 2009-indexed total project capital cost of $1.96 billion by 2.19 million HHE gives an estimated 2009-indexed cost of approximately $895 per HHE. Converting this to an annual debt service figure using typical PENNVEST rates, the annualized 2009-indexed total project capital cost becomes $56/HHE/yr.
- Dividing the estimated $61 million per year increase in annual O&M costs by 2.19 million HHE gives an estimated increase cost of $28/HHE/yr.
- Adding the estimated 2009-indexed nutrient-related annualized capital cost of $40/HHE/yr to the O&M cost of $28/HHE/yr gives an estimated average 2009-indexed nutrient-related annual cost of $68/HHE/yr.
- Adding the estimated 2009-indexed total project annualized capital cost of $56/EDU/yr to the O&M cost of $28/HHE/yr gives an estimated average 2009-indexed total project annual cost of $84/HHE/yr.

These numbers must be used with caution as they represent estimated average values for the entire body of significant dischargers. Actual discharger-specific impacts to user rates will vary significantly for dischargers depending on current rates, rate increase history, and the discharger-specific capital and O&M costs.

9.0 CONSIDERATION OF ALTERNATIVES TO FACILITY UPGRADES

A portion of the survey was structured to examine the degree of consideration that dischargers had given to alternative means of achieving TN and TP reduction to meet cap loads in lieu of or in conjunction with facility upgrades. The alternatives that were examined included:

- Facility operational changes
- Purchase of nutrient credits
- Elimination of existing on-lot septic systems through new connections to the sewer system
- Seasonal land application of treated wastewater
- Other alternative approaches

This Section summarizes the degree to which dischargers considered these alternatives, with the exception of nutrient credits, which are discussed and evaluated in greater detail in Section 10.

The survey asked respondents to select the statement that best described the degree to which each alternative was considered or adopted (or planned for adoption) as a means of achieving nutrient reduction:

1) Planned or implemented in lieu of facility improvements – i.e., cap loads would be met with no facility improvements

2) Planned or implemented in addition to facility improvements – i.e., the alternative was or will be used in conjunction with facility improvements to meet cap loads

3) Considered but not implemented – i.e., the alternative was considered but not selected as part of

the overall approach to meeting cap loads

4) Not considered – i.e., alternative was not considered; therefore it is unknown whether it would be a viable means of achieving nutrient reduction

Figures 9.1 – 9.3 summarize the responses from dischargers regarding the degree to which facility operational changes, elimination of on-lot septic systems, and seasonal land application of treated wastewater were considered, respectively. A discussion of the responses follows each figure.

Respondents were given the opportunity to describe any other alternatives to facility upgrades that were considered or implemented. One respondent indicated that they were looking into land application of biosolids. Many respondents left this section blank or entered "not applicable". Many others described the various facility improvement alternatives that were considered.

Figure 9.1

Consideration of Facility Operational Changes

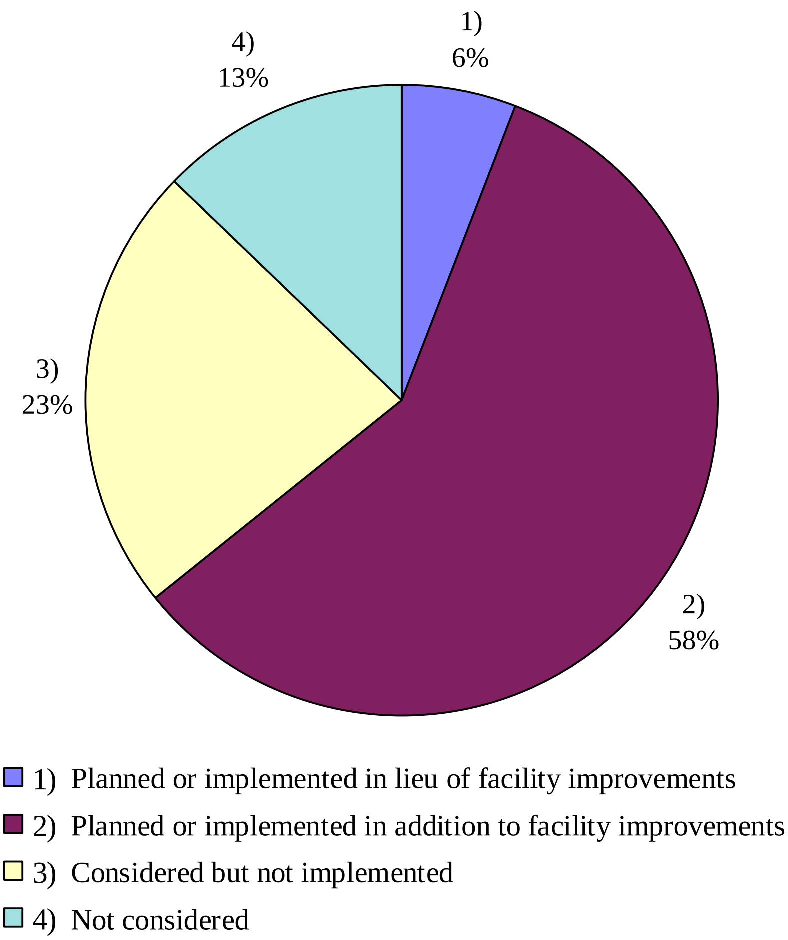


Figure 9.1 shows that the majority of respondents (64%) responded 1) or 2), indicating that facility operational changes were implemented (or planned to be implemented) in an effort to meet nutrient cap loads. Thirteen percent of respondents selected response 4), indicating that facility improvements were not considered, but most of these respondents either currently meet their nutrient cap loads, plan on purchasing nutrient credits, or are not far into planning stages. M&E was surprised by the percentage of respondents selecting response 3), indicating that facility operational changes were considered but not implemented. A closer look at other survey responses (particularly to B19) revealed that most of the respondents who selected 3) as a response would have more accurately been categorized by response 2) because their process changes inherently required facility improvements. The conclusion is that the respondents tried to make the most use of existing facilities to meet nutrient cap loads, but to reconfigure treatment processes, facility improvements were required.

Figure 9.2

Consideration of Elimination of On-Lot Septic Systems

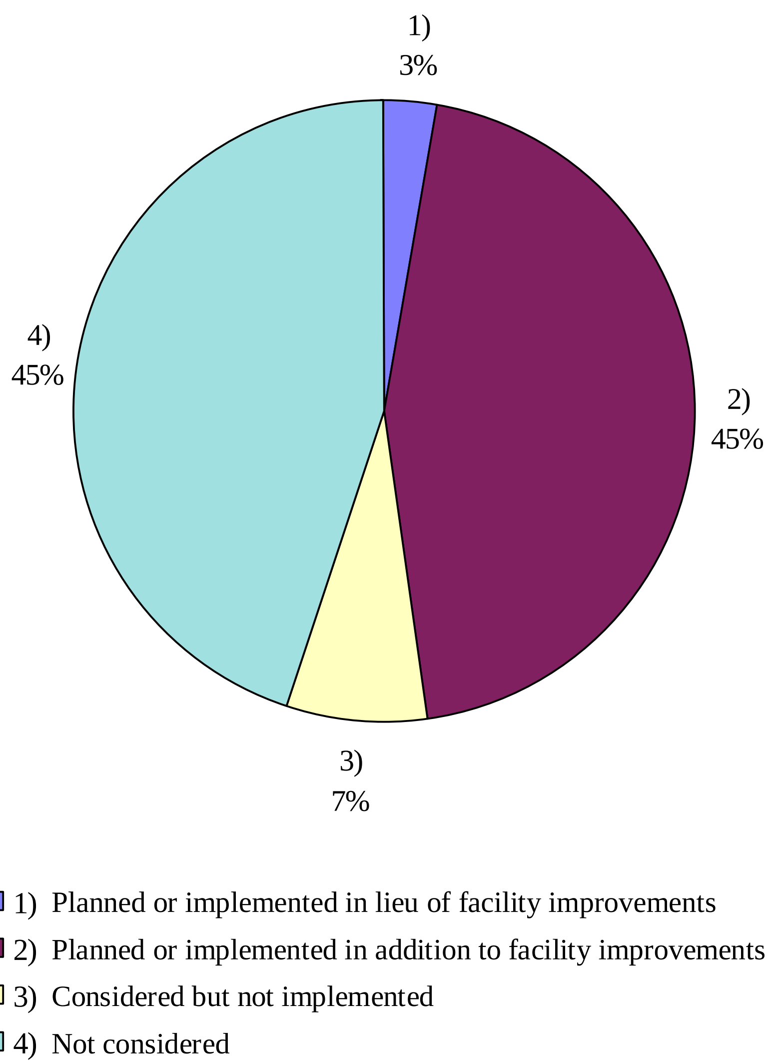


Figure 9.2 shows that about half of the respondents have either implemented (or plan on implementing) new sewer connections to eliminate existing on-lot septic systems, while about half of the respondents have not considered this alternative. Based on follow-up with the representative sample of dischargers, reasons for this alternative not being considered were either a) that the service aera was already built-out or b) that the currently non-sewered areas are of low density such that cost of collection systems would cost more than facility upgrades.

Figure 9.3

Consideration of Seasonal Application of Treated Wastewater

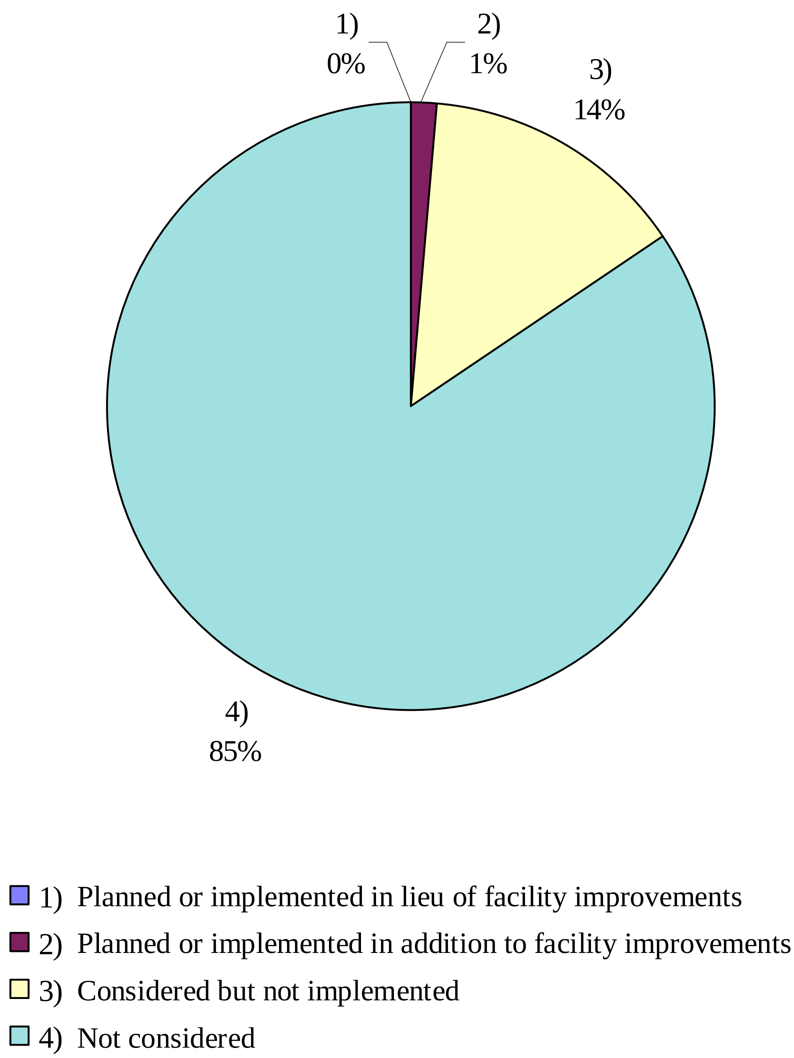


Figure 9.3 shows that the majority (85%) of the respondents had not considered seasonal land application of treated wastewater. Based on follow-up with the representative sample of dischargers, this alternative not considered because of cost. The main cost driver is the large amount of land of suitable quality needed for land application. However, other cost factors include the design and construction of the land application system, permitting, monitoring, and testing. Another intangible cost or barrier to land application is public conception of safety issues.

10.0 NUTRIENT CREDIT TRADING PROGRAM ASSESSMENT

10.1 Consideration of Nutrient Trading as an Alternative

Municipal wastewater (point source) dischargers to the Chesapeake Bay watershed (Dischargers) may achieve their nitrogen (N) and Phosphorus (P) cap loads, either in conjunction with facility upgrades, or entirely through nutrient trading. Dischargers were surveyed and interviewed to examine their opinions and perceptions about using nutrient trading as an alternative. This section describes survey and interview results.

Summary of Results from Point Source Opinion Survey

The following survey results were collected from wastewater treatment plant managers, operators, consultants, engineers, and other decision makers within Pennsylvania's Chesapeake Bay Watershed involved in deciding whether treatment plants should participate in Pennsylvania's Nutrient Trading Program (PANTP). An online survey was distributed to numerous wastewater treatment plant personnel. A total of 42 entities participated in the survey. The respondents were represented by Dischargers in all three (3) phases of the Pennsylvania Department of Environmental Protection's (PADEP) compliance plan, and from different regions of the Chesapeake Bay Watershed. The survey questions and responses are included in Appendix E and the list of respondents is included in Appendix F. Generally, the respondents expressed the following:

Understanding

- Most of the respondents (76%) described themselves as having either a moderate level of understanding or little to no understanding of the PANTP
- The majority (58%) were somewhat willing or very willing to explore the option of nutrient trading
- A high percentage (57%) of respondents were aware of the program, but not considering trades

Cost

- Most often cited price for purchase of a pound of N was thought to be $9; Over two-thirds (68%) of those responding perceived the price to be between $7 and $9
- More than 40% were not willing to pay more than $3 per pound of N
- Most commonly perceived price for purchase of a pound of P was thought to be $4
- Most (77%) of respondents thought the price for credits was NOT well documented

Risk

- Respondents overwhelmingly responded that the program was uncertain and unstable, with 86% choosing either "somewhat uncertain and unstable" (43%) or "highly uncertain and unstable" (43%)
- Respondents were asked to rank a set of nutrient trading considerations, and stability/reliability was rated as the most important factor to consider when purchasing credits (rated 4.38 out of 5), followed by uncertainty of price of credits (4.36).
- Respondents described the status of the PANTP as either "incomplete with unproven success" (57%), or "somewhat incomplete" (26%)
- Over 62% believe that the complexity of the PANTP is an obstacle to participation, while 21% disagree

- Most (66%) were concerned that future TMDL limits may make credit purchases obsolete

Trading

- A majority of the respondents (62%) preferred acquiring credits from a "bank", while 29% were willing to deal privately with a farmer or other municipality
- Only 3% were willing to deal with a broker to acquire credits
- Most respondents (58%) preferred the reduction of nutrients (BMPs) as a method of generating credits, and only 3% preferred manure export, while 39% didn't care
- Most (45%) don't know if the "current" availability of credits is sufficient compared to what is needed, while 34% responded they are less than sufficient

Compliance

- Almost all (91%) believe that number of credits available in future years is undefined, resulting in a risk of future non-compliance
- Effluent N cap loads were the only concern for 50% of the respondents, but 46% were concerned with both N & P loads

Summary of Point Source Discharger Telephone Survey Results

Four Dischargers who responded to the on-line survey and whose sites were visited as part of the validation process were selected to participate in a follow-up telephone interview. The Dischargers selected to participate in the interview were based on size (range in flow from 1 to 6.8 mgd), implementation phase (Phase 1 and Phase 2/3 Dischargers), and geographic location within the watershed. The purpose of these interviews was to review the Discharger's responses to the opinion survey questions, for clarity and more in-depth understanding of the perceptions and concerns of the dischargers. Appendix F contains information related to the Dischargers and a summary of the interview. The following is a brief summary of these interviews.

- All said they had talked about nutrient trades, but were unlikely to consider trades, regardless of costs
- Barriers to participation in the PANTP were reported to be:
    - cost
    - reliability
    - TMDLs,
    - uncertainty about future costs of credits
    - availability of credits
    - differing time horizon
    - fear of the unknown
    - annual certification required for credits
    - need for other plant improvements
- None had sought a price to purchase N and P credits, but believed $9 for N and $4 for P was the actual price

- One out of four said there was a better chance of controlling their own destiny with facility construction, and would not consider trading, regardless of cost
- One realized that O&M costs (especially power costs) were going to be higher if they moved forward with construction

Overall, Dischargers who participated in telephone interviews tended to confirm the results of the on-line survey. Two themes were expressed by all:

- There was a great deal of skepticism about whether the program would succeed.
- Trades were viewed as "risky" and should not be considered by pubic agencies.
- One Discharger felt that farms should be regulated or that farms should receive funds to reduce their loads to the bay, without considering trading.

Non Point Source to Point Source Discharger Trades

As part of this assessment, we reviewed the basis of two credit trades; Mount Joy Borough Authority (MJBA) with Brubaker Farms, and Fairview Township with Red Barn Trading Company. Both credit trades involved NPS to point source discharger trades. The cost of compliance appeared to be the driving force in both credit trades. Interviews were conducted with MJBA and with Lancaster County Conservation District personnel to gather information about the MJBA trade, and an interview with Fairview Township's engineer was conducted to assess the Fairview Township trade. A brief summary of the basis of the trades follows.

- MJBA/Brubaker Farms – The term of this trade was for three (3) years. Authority personnel were progressive in thinking about the trading program. They considered cost and rate structure needed for capital improvements, educated themselves about trading, took advantage of an existing relationship with the conservation district, and brokered a deal with PADEP to extend their compliance date until 2011. Some of the transaction costs were avoided as the result of a grant to the conservation district. Comments from Authority personnel about the nutrient credit trading program included –
    - The need for dischargers to better educate themselves about the program;
    - A preference for trading with a local farmer or trading with an entity that acts as a clearinghouse for buying and selling credits at set prices; and,
    - The need for a means/agency for validation of the nutrient credits.
- Township of Fairview/Red Barn Trading Company – Township and Authority leaders were very apprehensive about the costs to ratepayers for an upgrade to the treatment facility. After Township/Authority leaders, their engineer, and Red Barn discussed options, they were able to generate a unique approach tailored to suit the Township's needs. This trade involved purchase of nutrient credits for fifteen (15) years starting in 2010. With the trade, the cost for compliance with Chesapeake Bay requirements will be 75% less than the cost to upgrade.

10.2 Factors to Consider for Point Source to Non-Point Source Trading

List of Factors

The following is a "list of factors" a Discharger would need to consider when deciding whether or not to participate in Pennsylvania's Nutrient Trading Program (PANTP) as currently constituted. Although the list of factors relates primarily to dischargers purchasing nutrient credits from non-point sources (NPS) to use as offsets to achieve Chesapeake Bay cap loads, it is useful for Dischargers considering point source to point source trades as well.

The list is based on results of the nutrient trading survey (summarized above), telephone interviews with representatives of Dischargers (listed in Appendix F), and related municipal decision-making personnel (See Appendix H) within Pennsylvania's Chesapeake Bay Watershed. The factors listed represent an amalgamation of commonly expressed points of consideration. Note that a common thread among respondent's comments is "risk" associated with the PANTP. A brief description of each factor is provided for clarification.

Table 10-1
List of Factors to Consider for Point Source to Non-Point Source Trading

1. Cost of construction verses cost of purchasing credits
Description - The cost for a Discharger to construct facilities to meet N and/or P cap loads compared to the cost of purchasing N and/or P credits from NPS. The decision to participate in the nutrient trading program is reported to be primarily an economic one involving present worth engineering analysis for construction of new facilities to remove N and P. Most PS dischargers did not know the price of nutrient credits trades already made.
2. Present and future Price of credits
Description - The current and future cost for PS dischargers to purchase N and P credits from NPS. During the interview process it became clear that the market has not yet adequately developed price structures to the satisfaction of buyers and sellers. This uncertainty leads many would-be participants to hesitate.

Table 10-1 (continued)

3. Future regulatory requirements and possibility of change

Description - Future PADEP or EPA regulatory changes for Dischargers over a 20-year planning cycle, and/or regulatory changes that impact calculation of NPS N & P credits from manure use or BMPs.

In particular, there is a widespread concern that future TMDL stream segment nutrient obligations will not be satisfied by nutrient trades with entities on other stream segments. In many cases, it was reported by Dischargers that stringent stream-specific regulations, without the option of credit trades with entities on other stream segments would render the PANTP irrelevant for them.

A substantial majority of respondents perceive the future regulatory framework as highly uncertain.

4. Risk associated with program

Description - Primarily a function of knowing that the trading program will continue, and that NPS credits can be renewed over a long time frame and verified.

Dischargers report that forgoing plant upgrades now, when there is a political basis for them, in favor of buying nutrient credits must be justified in terms of future rewards outweighing risk.

Dischargers report that municipalities tend to be risk averse, and are uncomfortable “playing” (the word used by a respondent) with taxpayer money in what they see as an uncertain gamble in a risky market.

5. Bidding requirements

Description - Municipal bidding requirements are set by law, and are interpreted by Authority solicitors.

Some municipalities reported that they are constrained by legal requirements (such as the Municipal Authorities Act) to undergo a bidding process before spending municipal funds. The nutrient trading program is not set up with a bidding-oriented structure.

Some municipalities report that their own specific purchasing requirements may not be clearly met within the trading models available through PANTP.

6. Availability of credits

Description - The number of N & P credits available from NPS for purchase by Dischargers.

For the most part, dischargers report that they think in terms of decades-long plant operations, while credits are usually available within a shorter time horizon.

PADEP certifies credits for the year in which they are generated. Long-term credits must be re-certified in the year they are made available. Almost all Dischargers (91%) report that this creates uncertainty as to the availability of credits when they are needed.

Table 10-1 (continued)

7. Stability and reliability of program

Description - Reliance on the nutrient trading program to meet regulatory obligations and possibility of failure to meet those obligations due to program instability.

Possible program failure was reported as a strong concern for several dischargers.

Many dischargers report that they are waiting for the program to demonstrate its reliability before they consider trading.

8. Access to guidance and availability of other sources of information

Description - Prepared guidance in an easily understood format, readily available supporting documentation/information, and training opportunities.

Several dischargers were not aware of existing information available from sources such as websites, articles, and conference proceedings.

Unambiguous information about the benefits, costs, and risks of trading is essential for consideration of this option.

9. Complexity of program

Description - Unknown and unpredicted aspects of the program.

In comparison to readily defined issues relating to plant upgrades, dischargers report that nutrient trading appears to be much more complicated.

In order to be comfortable with trading, dischargers require clear instructions for navigating the complexities of transactions.

10. Timing of improvements verses the timing of credit purchase

Description - Timing of Discharger plant upgrades that are planned years in advance and how nutrient trades may play into their overall strategy.

Planning for purchasing credits years in advance is seen as a highly risky choice.

Forgoing plant improvements in favor of nutrient credit trades is fraught with uncertainties relating to future availability, price, and regulatory requirements.

Table 10-1 (continued)

11. Environmental Outcome
Description - Future, measurable reductions in N & P loads to the Chesapeake Bay. Comments collected from the survey of Dischargers include skepticism that a reduction in Bay nutrients will occur through non-point source trading. Several Dischargers reported that they believe the ideal nutrient trading program would reduce the cost of compliance with nutrient discharge regulations and lead to an overall reduction of nutrient load to the Bay. Several participants expressed eagerness about the overarching goal of meeting nutrient reductions and willingness to do their part. For some, "doing one's part" is seen as reducing one's nutrient load and not as buying credits from another entity while continuing one's own discharge at current levels. Contribution to a larger environmental goal is a consideration for some.

Assess Likelihood of Point Source Participation in Nutrient Trading

Based on the consensus of opinions expressed by the Discharger community, and the factors that must be considered in order to participate in nutrient trading, it appears unlikely that nutrient trading in its current form and with the current level of understanding will be seriously considered by most Dischargers as a viable alternative to construction of facilities. These themes were recurrent:

- Responses to the survey/interview questions indicated that cost was one of the most important factors in the decision to participate in nutrient trading. However, most responders were uncertain as to the cost per pound of nutrients available from NPS trades.
- Risk appeared to be another key concern for Dischargers. Perceived risk of non-compliance with NPDES permit requirements was evident in the nature of responses to a number of questions involving reliability, uncertainties, availability of credits, and future regulatory requirements.
- Dischargers need more information to make informed decisions about participation in the PANTP.

10.3 Nutrient Credit Generation Potential for Agricultural Practices in the Pennsylvania Nutrient Trading Program

Background

This section gives estimates of the potential for generation of nutrient credits from agricultural practices within the Pennsylvania Chesapeake Bay Watershed in the context of the PANTP. All estimates are based on current PADEP recommended guidelines for Pennsylvania. Only N and P were targeted for this portion of the study, and estimates do not include other nutrients, sediments, or credits from point sources.

Agricultural activities capable of generating credits involve changes in farming practices designed to reduce nutrient discharges into waterways. In this study, we focus on two commonly-used methods for generating agricultural nutrient credits:

- manure treatment or export; and
- land-based best management practices (BMPs).

Nutrient trading between Dischargers such as wastewater treatment plants and non-point source (NPS) dischargers such as farms is a key goal of the PANTP. It is generally assumed that costs of implementing BMPs and sensible manure practices to reduce NPS nutrient loads might be lower than the costs of treating wastewater treatment plant effluents to meet nutrient loads. Because NPS contribute a greater share of nutrients to the Chesapeake Bay than the Dischargers, their inclusion in the CBTS is thought to be crucial for its success.

In this part of the study, we sought to establish a realistic estimate of the number of nutrient trading credits that could be generated in the watershed given the initial conditions of current farm practices. The data largely come from the USDA Agricultural Census of 2002 and consist of detailed estimates of farm acreage, crops, and livestock by county in Pennsylvania. From this dataset we have extrapolated manure production, crop nutrient need, and BMP potential.

The findings of nutrient credit generation potential are presented in three main tables. Table 10-2 gives a summary of the estimates for credit generation potential in Pennsylvania for the Chesapeake Bay Watershed. Table 10-3 gives a more detailed summary of land-based BMP credits. Table 10-4 outlines the basis of assumptions used to generate Tables 10-2 and 10-3. Tables 10-2 and 10-3 are cross-referenced with Table 10-4 so that all assumptions can be clearly identified, along with inherent limitations/uncertainties of each assumption, based on the limited amount of readily available data.

Limitations of Estimates of Potential N and P Credits from Non-Point Sources

Limitations on the methodology of estimating N and P credits deserve note – credit generation estimates should be approached with an appropriate amount of caution. The most crucial limitations are lack of data about:

- agricultural land in the watershed able to meet the “baseline” requirements for participation in the program;
- the amount of manure currently applied to land as a soil fertility amendment; and
- the amount of commercial fertilizer applied to agricultural land.

The limited availability of data makes it difficult to assign confidence limits on the estimation of NPS trading credits potentially available in the Pennsylvania Chesapeake Bay watershed. It was particularly difficult to determining the number of farms in the watershed able to meet baseline, and the use of manure in the watershed. This type of estimation is beyond the scope of the current assignment and resources were not provided for an exhaustive investigation in this study. Therefore, we recommend a follow up study to refine this estimate.

To fill the gaps where good data are lacking, several blanket assumptions were made based on consultation with knowledgeable experts (listed in Appendix H). As noted above, assumptions used and limitations of the estimates of the potential N and P credits are described in Table 10-4. Table10- 2 should be interpreted in conjunction with assumptions listed in Table 10-4.

An issue not addressed in our estimate is the financial incentive required to change farming practices. While a potentially ample number of credits appear to be available, this availability requires that farmers are sufficiently motivated to generate credits. In the absence of financial incentives sufficient to offset the costs associated with BMP implementation and motivate farmers, it is unlikely that the values shown in Tables 10-2 or 10-3 can be achieved.

Potential Credit Generation of Nutrient Trading Credits

Estimates of nutrient trading potential in Pennsylvania's Chesapeake Bay Watershed total 13 million pounds for N and 1.3 million pounds for P, as shown in Table 2. Manure export and/or treatment accounts for 9 million pounds of N and 1 million pounds of P. Under current trading recommendation guidelines, selected BMPs are capable of generating 4 million pounds of N and 0.3 million pounds of P.

In its Tradable Load document (chesapeakebay.net/uaasupport.htm), PADEP released estimates of the total nutrient load to the Bay from agriculture in the state in a best-case scenario. The estimates for the so-called E3 scenario were 21 million pounds of nitrogen and 1.9 million lbs. of phosphorus. The E3 scenario represented an upper limit of nutrient and sediment load reductions in which "everything, everywhere, by everybody (E3)" is done to reduce nutrient loads. In order to set the maximum amounts of nutrient loads that could be traded, the E3 estimate was subtracted from the *Pennsylvania Tributary Strategy* loadings goal. The resulting values of 5,760,000 lbs N/yr and 397,000 lbs P/yr were given as the maximum allowable credits that could be traded within the program.

The estimates provided in this report of 13 million lbs./yr. and 1.3 million lbs./yr. for N and P credits respectively are substantially higher than the maximum allowable trading loads mandated by PADEP. This indicates that the potential number of nutrient credits available from agriculture for trading may ultimately be regulatorily limited rather than by their potential availability.

As such, the DEP mandated limit of 5.76 million lbs./yr. for non-point source N credits represents a realistic measure of availability, and can be used to make comparisons to the requirements for Dischargers. The Chesapeake Bay Compliance Plan (Fact Sheet, DEP website) estimates a required N removal of 5.5 million lbs./yr for significant point source dischargers (including non-municipal sources). More recent discharge data obtained from the DEP data management section for the first half of 2007 for the 183 Dischargers indicates a 2010 removal requirement of 6.2 million lbs./yr. and a design discharge removal requirement of 12.3 million lbs./yr.

So, over 100% of the potential market for supply of N credits would be needed in the next two years to meet the entire 2010 requirement. Based on estimates for the representative sample of 20 Dischargers that were studied in more detail (see Figures 10.1 and 10.2), about one-third of the Discharger N removal requirement may be more cost-effectively addressed by nutrient trading. This yields a more reasonable but still quite daunting 2010 market development requirement of 36%. As of October 2008, the approved N credit supply has grown to just over 700,000 lbs./yr., (12% of the 5.76 million lb./yr. market) indicating reasonable progress in the 20 months since the program's inception. Since the actual trades registered (34,000 lbs/yr) represent only 5% of the available supply, it would appear that the primary challenges to market development lay on the demand side, at least in the short term.

Table 10-2
Summary of Estimates for Credit Generation Potential of Nutrient Trading Credits in the Pennsylvania Nutrient Trading Program

Activity	Potential Annual Credits (in pounds)
Manure Export or Treatment	
Nitrogen	9,000,000[a]
Phosphorus	1,000,000[a]
Selected Land-Based Best Management Farming Practices (BMPs)	
Nitrogen	4,000,000[b] (600,000 to 4,000,000)[c]
Phosphorus	330,000[b] (130,000 to 330,000)[c]
Total Non-Point Source Nutrient Credit Potential	
Nitrogen	13,000,000[ab]
Phosphorus	1,300,000[ab]

[a] See Table 10-4 items 1,15,16,17,18,19,20,21 for assumptions used to generate manure export or treatment (BMP) credit potential estimates. This value assumes that 100% of the manure not used to meet crop nutrient needs and available for export can be exported and that receiving sites outside of the watershed are always available.

[b] The value shown is for BMPs of no-till farming, cereal cover crops, and water control structures applied to all farm acreage estimated to be eligible in the watershed. We assume that 40% of farms in the watershed operate under conservation plans and are eligible to participate in the program (see table 10-4). See Table 10-3 for details about BMP credit generation potential, and Table 10-4 assumptions 1-14 and 20 for assumptions used to generate BMP credit potential. Other BMPs could be used to replace those listed, yielding similar credit potential results. The actual value of acreage likely to implement BMPs is likely to depend, to a great extent, on financial considerations. A cost-benefit analysis of farming behavior in light of BMP and credit incentives is strongly needed.

[C] The range in values given in BMP estimates reflects a range in possible BMP practices. The low value is given for a minimal land use change to no-till agriculture. The high value represents the multiple BMPs indicated in footnote b.

Overview of Credit Generation Potential Methods

Estimates of manure export and treatment credits were determined by the following process.

1. Collect livestock population data for counties in the Chesapeake watershed from the USDA Agricultural Census (USDA, 2005).
2. Estimate animal type/number manure production data using Penn State Agronomy Guide approximations (Penn State, 2008).
3. Estimate manure N and P content and availability values using the Penn State Agronomy Guide (Penn State, 2008).
4. Estimate the amount of manure required to meet crop nutrient needs in the watershed after accounting for the use of commercial fertilizers to meet crop need.
5. Estimate the number of nutrient credits available from exporting the remaining manure using an existing manure trade as a template for the credit generation methodology (PADEP, 2007). The trade used as a calculation template is the Red Barn Trading Company Nutrient Credit Trading Proposal for Client 0136 in Mount Joy, Lancaster County. See Appendix G, Table G2 for calculation methodology.

Estimates of credits available from implementing BMPs were determined by the following process.

1. Collect data about land use, farm acreage, and crop frequency in Pennsylvania's Chesapeake Bay from the USDA Agricultural Census (USDA, 2005).
2. Extrapolate crop nutrient requirements from crop population and typical yield data published in Penn State Agronomy Guide (Penn State, 2008).
3. Gather data about typical fertilizer practices in central Pennsylvania from USDA Economic Research Service: http://www.ers.usda.gov/Data/FertilizerUse/ (Wen Huang, 2007)
4. Apply fertilizer use data to nutrient need of existing crops.
5. Apply manure use to satisfy the balance of crop nutrient requirements.
6. Apply calculations for BMP efficiencies to crop land using the methodologies given in nitrogen and phosphorus calculation spreadsheets available from PADEP at: http://www.dep.state.pa.us/river/Nutrient%20Trading.htm#Registry

Credit Generation Potential from Best Management Practices on Farmland

For the purposes of this report, the credit generation calculations for BMPs are based on the current recommended methodology described on the PADEP website, at http://www.dep.state.pa.us/river/Nutrient%20Trading.htm?chesapeakeNav=|#Calculation. Greater reduction may be possible on a case-by-case basis, as approved by PADEP.

Calculations for credits generated by land-based BMPs take the basic mathematical form:

$$(\text{Credit Potential}) = (\text{Nutrient Load}) - ((\text{Nutrient Load})*(1-\text{BMP})*(1-\text{BMP})*(1-\text{BMP})*(1-\text{BMP}))$$

where (Credit Potential) is the potential for a set of farming practices to generate credits before reductions relating to location within the watershed, PADEP reserve reductions, and efficiency are calculated; (Nutrient Load) is determined by the fertilizer and manure practices implemented within the limits of the crop need; and (BMP) is a value less than 1, given in the Chesapeake Bay Watershed Model, representing the established efficiency of the BMP practice. The formula is from the Chesapeake Bay Watershed Model given in nitrogen and phosphorus calculation spreadsheets available from PADEP at:

http://www.dep.state.pa.us/river/Nutrient%20Trading.htm#Registry. More information about the formulas for BMP efficiencies is given in Table 4, assumptions 7-14.

The BMPs used to calculate credits in tables 10-2 and 10-3 were chosen so as to give a realistic estimate of the credits that could be generated on farmland in the watershed. The chosen BMPs:

- represent typical efficiency values for BMPs
  - typical values are in the range or 0.10 to 0.45 for nitrogen, and 0.07 to 0.40 for phosphorus (efficiency values range from 0 to 1 for all BMPs)
  - no-till efficiency ranges from 0.10 to 0.15 for nitrogen, and 0.2 to 0.4 for phosphorus
  - cover crop efficiency ranges from 0.30 to 0.45 for nitrogen, and 0.07 to 0.15 for phosphorus
  - water control structures give a value of 0.33 for nitrogen and 0.0 for phosphorus
  - Table 10-3 shows a "theoretically" perfect BMP with an efficiency of 1 and can be seen as an upper bound to the possible BMP credit generation potential
- are relatively easy to implement
  - no-till and cover crops are commonly practiced BMPs for which equipment and expertise are readily available
  - water control structures are more easily implemented than major land-use changes
- do not permanently change agricultural land
  - options such as reforestation of agricultural land were ignored though they can result in high BMP efficiencies (0.85 to 0.94 for nitrogen and 0.34 to 0.99 for phosphorus)

It is noteworthy that a theoretical "perfect" BMP with an efficiency value of 1 has a credit potential equal to the total nutrient load applied to the land (with some reductions based on geographic location and other factors). There are no actual BMPs with an efficiency of 1, but some practices, such as conversion of some types of land to forestry give efficiencies as high as 0.94 for nitrogen and 0.99 for phosphorus. This is the maximum possible value of BMP credits for a given nutrient load on the land. All BMP practices result in lower credit potential than this "theoretical" value. The theoretical value represents a ceiling of nutrient credits available from BMPs for a given agricultural practice. Theoretical values are shown in the rightmost column of Table 10-3.

Table 10-3. Potential Nutrient Trading Credits from Land-Based Best Management Practices. Typical crop yields are assumed according to the Penn State Agronomy Guide, 2007-2008. Manure application is assumed to provide 79% of crop nutrient need and commercial fertilizer is assumed to provide 21% of crop need. See Table 3 for list of assumptions used to generate estimates.

Land Use[a]		BMPs[b]					
Crops	**Acres in Watershed[c]**	**No-Till**	**Cover Crop**	**No-Till and Cover Crop**	**Water Control Structure**	**No-Till, Cover Crop, and Water Control Structure**	**Theoretical Maximum BMP[d]**
		N Credits (lbs) for BMPs (all acres implementing BMPs)					
Corn (Grain and Silage)	817,000[c]	570,000[e] to 856,000[e]	1,700,000[e] to 2,500,000[e]	2,100,000 to 3,000,000	1,800,000	3,300,000 to 3,900,000	5,800,000
Soybeans	236,000[c]	0	0	0	0	0	0
Wheat	103,000[c]	38,000 to 57,000	115,000 to 174,000	140,000 to 210,000	130,000	220,000 to 260,000	400,000
Forage & Hay	1,060,000[c]	na	na	na	na	Na	na
		P Credits (lbs) for BMPs (all acres implementing BMPs)					
Corn (Grain and Silage)	817,000[c]	95,000 to 190,000	33,000 to 71,000	120,000 to 230,000	Not defined	Not defined	500,000
Soybeans	236,000[c]	22,000 to 44,000	7,000 to 16,000	28,000 to 54,000	Not defined	Not defined	110,000
Wheat	103,000[c]	14,000 to 27,000	5,000 to 11,000	17,000 to 34,000	Not defined	Not defined	71,000
Forage & Hay	1,060,000[c]	na	na	na	Not defined	Not defined	na

[a] See Table10-4, assumption 3
[b] See Table 10-4, assumptions 1, 4-20
[c] See Table 10-4, assumptions 1, 2, 3
[d] The theoretical maximum BMP has an efficiency value of 1. The concept represents a maximum credit generation efficiency for a single BMP or combination of multiple BMPs. Actual BMPs have efficiency values < 1. See Table 10.4, assumption 10 for BMP formula used.
[e] Ranges of credit values for different BMPs are given because current accepted credit generation methods allow for site-specific variability beyond the scope of a general estimate. Accordingly, two estimates were made for each BMP when a range of possible values was given; one estimate represents the high end value for BMP efficiency and the other estimate represents the low end value for given BMP efficiency.

Table 10-4. Assumptions for Nutrient Trading Credit Estimates

Estimate	Assumption	Limitations of the Assumption or Estimate
County EOS (Edge of Segment) values, delivery ratios, farmland acreage.	1. The values of EOS and delivery ratios for any given county in the watershed can be simplified to the dominant EOS values and delivery ratio values for the county. 2. Farmland acreage and manure production values of a given county partially in the watershed are equal to the fraction of the counties within the watershed times the total acreages of the counties.	• EOS and delivery ratios for N and P given by PADEP do not always mirror county boundaries. Assigning single EOS and delivery ratios to a given county leads to unavoidable uncertainty because agricultural census data are not available for portions of counties. • Farmland is not evenly distributed within a county. Thus counties straddling watershed boundaries may have misleading acreage values. Also, animal agricultural operations are not evenly distributed within counties.
Crop acreage and land use	3. Values of acreage of land use types can be represented by the most recent Agricultural Census figures published by the USDA in 2002.	• Changes to economic incentives and other factors governing farming practices have occurred since 2002, and acreages for given practices have likely changed. • In particular, acreage of commodity crops

		may have increased since 2002 due to higher prices for commodities. Pasture and hay acreage may have decreased as land is converted to commodity crops. • If nutrient credit generation becomes a viable economic practice for farmers, further land use change is likely. Soybean acreage, for example, which is not able to generate N credits, may be changed to another land use.
Fertilizer usage	4. Values for the watershed are represented by values published for fertilizer use for the state of PA. Source: USDA Economic Research http://www.ers.usda.gov/Data/FertilizerUse/ with the balance of crop need being met by manure	• Fertilizer usage since 2002 has, in some cases, decreased in favor of manure use because of increased fertilizer prices. • Some crop need of nitrogen is met with fixation of atmospheric nitrogen.
BMP	5. The BMP efficiencies and the ranges in values for different stream segment areas within the watershed are given according to the Chesapeake Bay Watershed Model. (Chesapeake Bay Program, 2008).	• High and low values for BMP efficiencies were used to generate the ranges in credits available for implementing each given BMP or combinations of BMPs. The estimate encompasses extremes in efficiency based on geographic location.
Baseline requirements	6. 40% of agricultural land in the watershed meets baseline requirements of soil loss tolerance and/or nutrient management plans.	• This estimate is based on conversations with conservation district personnel. Data are not publically available about the number of farms in compliance with acceptable conservation plans (plans that meet soil tolerance or "T"). Other estimates given were as low as 20% or as high as 60%

BMP generation equations (follows PADEP recommended calculation method on PADEP website)	7. Agronomic rate of fertilizer on typical crop yield, and crop use efficiencies taken from Penn State Agronomy Guide, 2007-2008 8. Edge of field (EOF) nutrient load = (fertility applied) – (fertility taken up by crops) 9. Edge of segment nutrient load (EOS) = (simplified EOS ratio for county)*(EOF) 10. Nutrient reduction for BMPs = EOS – (EOS*(1-BMP efficiency)*(1-BMP efficiency)*(1-BMP efficiency)*(…)) 11. EOS load reduction = (EOS) – (N reduction for BMPs) 12. N load to reach edge of watershed segment = (EOS – N reduction)*(acres) 13. N reduction to Bay = (N Load to reach edge of watershed segment)*(delivery ratio) 14. N credits = (N reduction to Bay) – (N reduction to Bay*0.10) [to pay the PADEP reserve]	• Commercial fertilizer at agronomic rates is used with the BMP equations because individual farmer behavior, variations in crop yield, and variations in commercial fertilizer use are difficult to predict. • The BMP equations use the simplified EOS delivery ratios explained above. • The BMP equations and the EOS and delivery ratios are from the Chesapeake Bay Watershed Model (Chesapeake Bay Program, 2008). The Model is subject to modification and ratios may change in the future.
Manure	15. Assumptions: 21% of manure produced in the watershed is available to be exported; the balance is applied to meet crop nutrient needs. 16. Manure produced per animal unit is given in the Penn State Agronomy Guide, 2007-2008. 17. Number of animals is from the USDA Agricultural Census of 2002 and is converted to animal units according to the Penn State Agronomy Guide, 2007-2008. 18. Animal types are simplified (for example, one average value for swine instead of separate values for farrow,	• The value of 21% of manure available for export comes from examination of the agricultural nutrient balance in the watershed. Total crop nutrient need is assumed to be partially met by the total commercial fertilizer used (Wen Huang, 2007). The balance of crop need is assumed to be met by manure. The balance of the manure (on a nitrogen basis) is assumed to be available for export.

	lactation, nursery, gestation, etc.) 19. Credit generation methodologies are based on the Red Barn Proposal for Client 0136, April 5, 2007 (PADEP, 2007)	• The export estimate assumes that all excess manure is available to be exported. Some farms, such as grazing operations, have manure that is not easily recovered. The estimate should be considered high.
N Basis	20. Decisions about manure application as fertilizer and manure export are assumed to be made on a nitrogen basis.	• Almost all farms in the watershed manage manure on a nitrogen basis as directed by the Penn State Agronomy Guide, 2007-2008. Exceptions include farms managing manure on a phosphorus basis, which is more stringent. The estimate assumes N-based management because no public data exist giving the number of farms managing manure on a P basis.
Manure Export/Treatment Generation Calculations	21. Specific calculation methodology for generating the manure export/treatment credit potential is assumed to be identical to the Red Barn Proposal for Client 0136, April 5, 2007 (PADEP, 2007). The calculation methods for that trade are shown in Appendix Table G-2.	• Some methodologies of credit generation have been revised and continue to be revised by PADEP.

10.4 Issues that May Affect Likelihood of Point Source to Non-Point Source Nutrient Trading

Structural Issues That May Affect Likelihood of Nutrient Trading

Structural issues are those elements of the PANTP and the regulatory framework that Dischargers operate within that create transactional costs and/or barriers to participation.

Transactional costs are those costs that are incurred to make a trade that are not reflected in the price or inflate it. Typical transaction costs are costs such as procurement and legal costs. Nutrient trading makes economic sense when the resultant cost of nutrient removal is less than the cost of plant upgrades for nutrient removal PLUS these transaction costs. A streamlined structure for the trading program can facilitate nutrient trading through low transaction cost, while a complicated structure can act as a deterrent to participating in the program by creating high transaction costs.

Barriers to participation are non-economic factors that discourage interest in trading such as perceived uncertainty and risk.

During this survey effort, a significant number of structural issues and associated transaction costs and barriers to participation were identified that affect the potential for Dischargers to use nutrient trading as an alternative to construction of facilities and plant upgrades. Many of these transaction costs and barriers (perceived or real) were manifested in the Discharger surveys as observations and concerns. (These are summarized in Section 10.1).

To interpret survey findings and identify structural issues related to the PANTP, we reviewed water quality trading documents from academic papers/articles and other water quality trading programs in the United States. We also conducted interviews (see Appendix H) with an environmental economist, technical developers/advisors to the Chesapeake Bay Program and the PANTP, aggregators, conservation district personnel, and other experts. Based on information from these reviews and all other interviews, we made observations relative to the current PANTP structure. Structural issues and associated transactional costs and barriers to participation we identified are as follows:

- **Regulatory Framework & Uncertainties**
    - Potential changes to EPA and PADEP regulations related to Dischargers (TMDLs in particular) may change the status of a nutrient trade after the transaction has taken place and render it moot. This uncertainty is creating a substantial chilling effect.
    - Potential changes to calculation methods for NPS credits, such as EOS, delivery ratios, and BMP efficiencies could impact the value of a credit and may change the status of a nutrient trade after the transaction has taken place.
    - Discharger legal sanctions associated with NPDES permit non-compliance are perceived as a major risk associated with relying on trading.
    - Discharger permit nutrient load limits have been phased and delayed out through 2013, which has deferred interest for a substantial portion of the Discharger Community and indirectly impacted the demand for nutrient credits and the development of the market.

- Integration of PANTP goals into water quality regulatory programs would provide assurance that future regulations will not jeopardize status of trades.

- **PANTP Implementation Policies**
  - There are no set standards for certifying credits, with complex, difficult to navigate requirements, and with indefinite approval times. These issues create transactional cost and a barrier to participation due to uncertainty.
  - Nutrient reduction credits can only be applied to nutrient reduction offsets in the year in which they are generated. This creates a mis-match with differing buyer and seller time horizons (long-term credit demand verses short term credit supply).
  - Verification "standards" for confirming implementation of credit generating projects do not exist – creates perception of risk with Dischargers.
- **Reliance on a Market-based approach**
  - Credits are available for sale, but only a small number of credit trades have taken place. Few sellers are willing to give long term guarantees of availability or firm long term pricing. As a result, there is currently little demand due to the long term need of the buyers.
  - There is considerable interest in a government-based Clearinghouse or "Bank" that would guarantee long term availability and firm pricing; however, there is no provision in the current program for this entity.
  - There are no well-established mechanisms for developers to transfer responsibility for maintenance of nutrient credits to homeowners or municipal entities, thereby suppressing potential for new development.
- **PANTP Guidelines and Support**
  - There is a perceived need for outreach and communication on the part of both buyers and sellers. A low level of understanding discourages participation.
  - Trading program guidance/educational materials are regarded as having limited usefulness and are not readily accessible. Prepared materials could be used as a tool to promote participation in the program and dispel misinformation.
  - No mechanism is in place for effective detection and correction of misinformation/misunderstanding of PANTP, which creates additional uncertainty.
- **Agricultural Credit Provider Restrictions & Support**
  - The requirement to achieve baseline [1] before being able to generate credits substantially increases the potential provider transaction cost and creates a strong disincentive for farmers to participate in the PANTP.
  - Costs to meet baseline are not well understood and guidance is not readily available. This creates uncertainty regarding a provider's ability to pay for upgrades or change practices and discourages participation.

[1] Baseline refers to compliance with all applicable agricultural compliance measures when seeking approval for credit generating projects.

- Many farming operations, in particular smaller ones, are economically marginal and there is no source of funding to bring farms to baseline in order to participate.

Non-Program Issues

The following issues are not structural issues as defined above, in that they are not created by the structure of the trading program and the regulatory framework for Dischargers; however, they need to be recognized and taken into account to design effective program modifications.

- **Farming Demographics and Culture**
  - The level of credit generation per acre from farm BMPs is modest. This may prevent smaller farms from reaching the "critical mass" required to overcome the transactional costs and dis-economies of scale and participate.
  - Farmers have traditionally participated in purely voluntary programs with no compliance requirements and will have a disinclination to participate in a one that is quasi-regulatory and involves verification of practices.
  - The basis for farm fertility management is N in almost all cases, and consequently P based management is likely to be neglected.
- **Discharger (Wastewater Management) Culture**
  - Municipal wastewater decision-makers/managers often defer to technical advisors and consultants. There is limited understanding of the PANTP by the consulting community.
  - Wastewater managers are traditionally more comfortable controlling their own risk, which they can do with on-site capital improvements, rather than delegating that risk off-site and to others.
  - Wastewater managers perceive less risk in trades between Dischargers because both have hard and verifiable regulatory requirements.

Assessment of Viability of Trading Program

This study has identified a number of Structural Issues associated with the PANTP as it is currently organized that affect the likelihood of facilities (Dischargers) using this alternative. The most significant barrier to trading is uncertainty. PADEP approved credits are currently available for sale (see Appendix I); however, there is currently little demand. Uncertainty surrounding the future price and reliable supply of credits causes concern about the viability of the program among the long-term focused Discharger community. Uncertainties are not just associated with cost, so that even if costs are acceptable to the buyer and seller, nutrient trading may be limited. Without assurance that future regulations and policies related to TMDLs and NPS requirements will not adversely affect nutrient trades between Dischargers and NPS, the Discharger community is likely to maintain its general aversion to considering purchasing credits in lieu of capital upgrades. Underscoring the importance of creating more certainty, we found considerable appeal among the Discharger community for reducing uncertainty by creating a government-supported clearinghouse for purchasing, selling, and setting the prices of nutrient credits.

Supply of NPS agricultural credits may be limited due to uncertain costs of bringing farms to baseline (which is required before credits can be generated) as well as the relatively small number of credits that can be generated with BMP implementation. Credits generated by treating manure or moving manure out of the watershed show more promise, but uncertainties discussed above and perceptions in the Discharger community that relocating manure is a questionable environmental practice pose challenges.

The PANTP is a unique, one-of-a-kind program in the United States and may require additional educational and outreach effort. At this point, the Discharger community does not have a good understanding of the program and market issues are not well understood.

The costs of various options, including the costs for construction of facilities and trading among Dischargers compared to trading with NPS are important considerations for Dischargers. Dischargers are comfortable operating in a regulated environment, and trading with other regulated entities. The fundamental premise of the PANTP is that compliance will take place through the least costly option when free-market forces are in play. Estimates of dollar cost of capital improvement-based nutrient removal for the 20 representative facilities selected for more in depth study (see Figures 10.1 and 10.2) suggest that a majority of facilities have a financial incentive to consider trading. However, at this point, under the current program, nutrient trading with NPS dischargers is rarely viewed as the most attractive option for Discharger compliance. In effect, the full cost (including transactional costs and "risk premiums") is perceived as greater than the cost of capital improvement-based nutrient removal. Without modifications, the PA Nutrient Trading Program is unlikely to be viable as a long-term option for would-be market participants given the structural issues, transactional costs, apparent barriers, and need for additional outreach and education. For the most part, present circumstances inhibit the development of willing buyers (demand) for credits currently available in the market place. The PANTP may work for a limited number of traders over the short-term, but long-term participation does not appear to be significant in the present configuration of PANTP. Without careful study of structural issues and barriers, followed by structural changes to the program and accompanied by a concerted education and outreach effort, this is unlikely to change.

10.5 Point Source Dischargers to Non-Point Source Trading Price Analysis

Average Price for Nutrient Trades

The prices for nutrient credits that have been sold in the nutrient trading program to date are summarized in Table 10-5. A summary listing of existing nutrient credits available for sale from Certified Credits on the PADEP Registry is included in Appendix I. This summary also provides a comparison of prices for credits that have been bought by participants in the program. Since there are only six (6) N trades to date, and two (2) P trades, "market" or "average" price is somewhat misleading. Prices for actual N trades, for example, range from $3.81 to $9.00 per annual pound.

As of October 1, 2008, there have been no nutrient credit trades between two point source dischargers. All trades have occurred between NPS and point source dischargers. The price analysis pertains only to NPS to point source discharger trades.

Table 10-5
Prices for Completed PADEP Trades

Credits Sold	N Credits	Price/credit	P Credits	Price/credit
	7,834	$4.00		
	146	$4.00		
	11,718	$3.81		
	223	$9.00	3	$4.00
	1,592	$9.00	73	$4.00
	20,000	$6.20		
Total	33,533		76	
Weighted Average		$5.52		$4.00
Sample Standard Deviation		4.79		0

Analysis of Nutrient Trading Price Points for Representative Sample of Dischargers

For the representative sample of 20 dischargers that were visited, M&E determined the 2009-indexed annual cost on a dollar-per-pound ($/lb) of TN basis for nutrient-related upgrades. The following approach and assumptions were used in determining the 2009-indexed annualized $/lb cost of nutrient-related upgrades:

- Total annual cost for facility upgrades equal annual debt service of capital cost plus additional annual O&M cost.
- Additional annual O&M costs were used as reported by each discharger. For dischargers that did not report estimated additional annual O&M costs but would have an anticipated increase in O&M cost due to the nature of the planned upgrades, the average O&M increase as presented in Section 7 was assumed based the discharger's flow group.
- Two scenarios were considered for the annual debt service on 2009-indexed nutrient-related capital cost for upgrades. One scenario assumes a loan term of 20 years at an interest rate of 6%, representative of conventional financing. The other scenario assumes a loan term of 20 years at an interest rate of 2.1%, representative of financing via PENNVEST.
- Two scenarios were considered for the amount of TN to be removed to meet cap load limit. One scenario was for "current" conditions, and the other was for "design" conditions. The amount of TN to be removed under current conditions was calculated as the discharger's current effluent TN load minus the discharger's cap load. For "design" conditions, the current effluent TN load was projected to design conditions using the ratio of current flow to design flow. The amount of TN to be removed under design conditions was calculated as the projected TN load minus the cap load.
- Cost analysis has been done on TN basis because nitrogen removal upgrades are the overwhelming factor behind the cost of upgrades.

Figures 10.1 and 10.2 present the 2009-indexed annual cost for nutrient-related upgrades versus percentage of the representative sample. Figure 10.1 and 10.2 present the same curves, except the scale on Figure 10.2 has been changed for clarity.

Figure 10.1
2009-Indexed Annual Cost for Nutrient-Related Upgrades versus Percentage of Representative Sample (Full Scale)

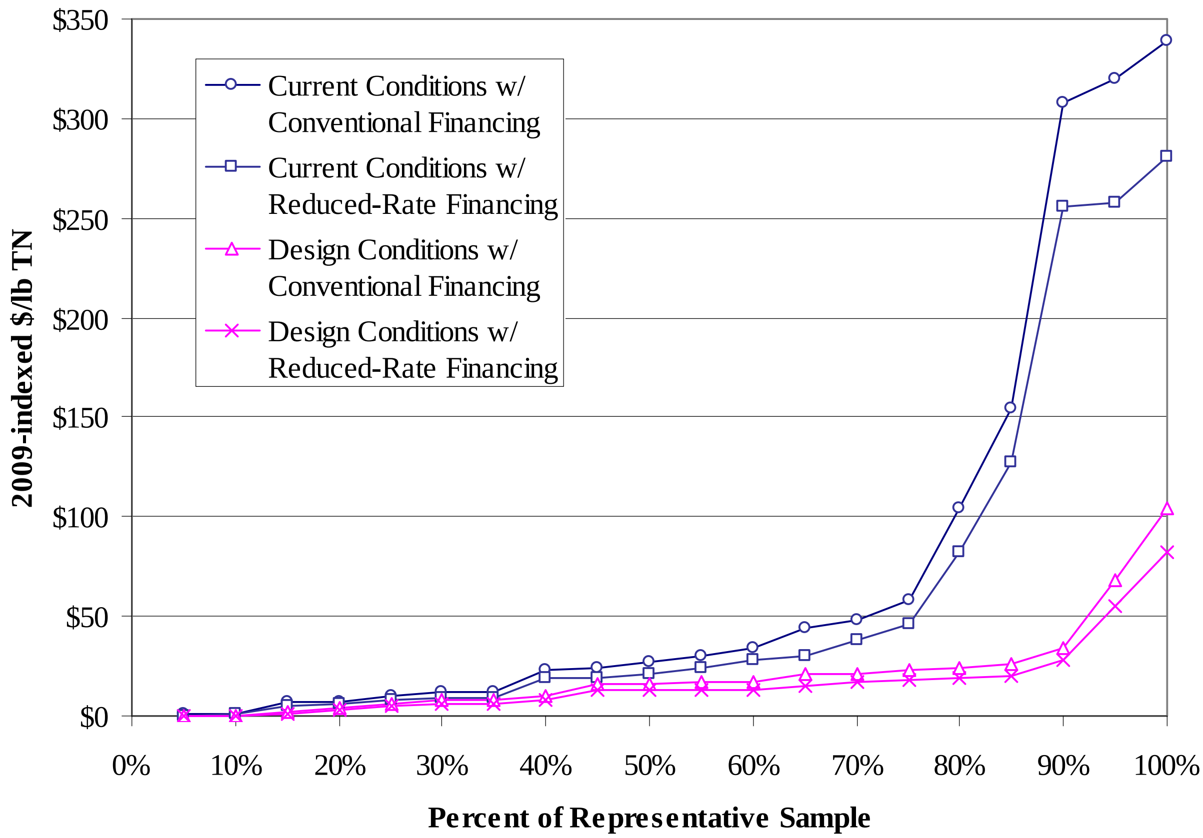
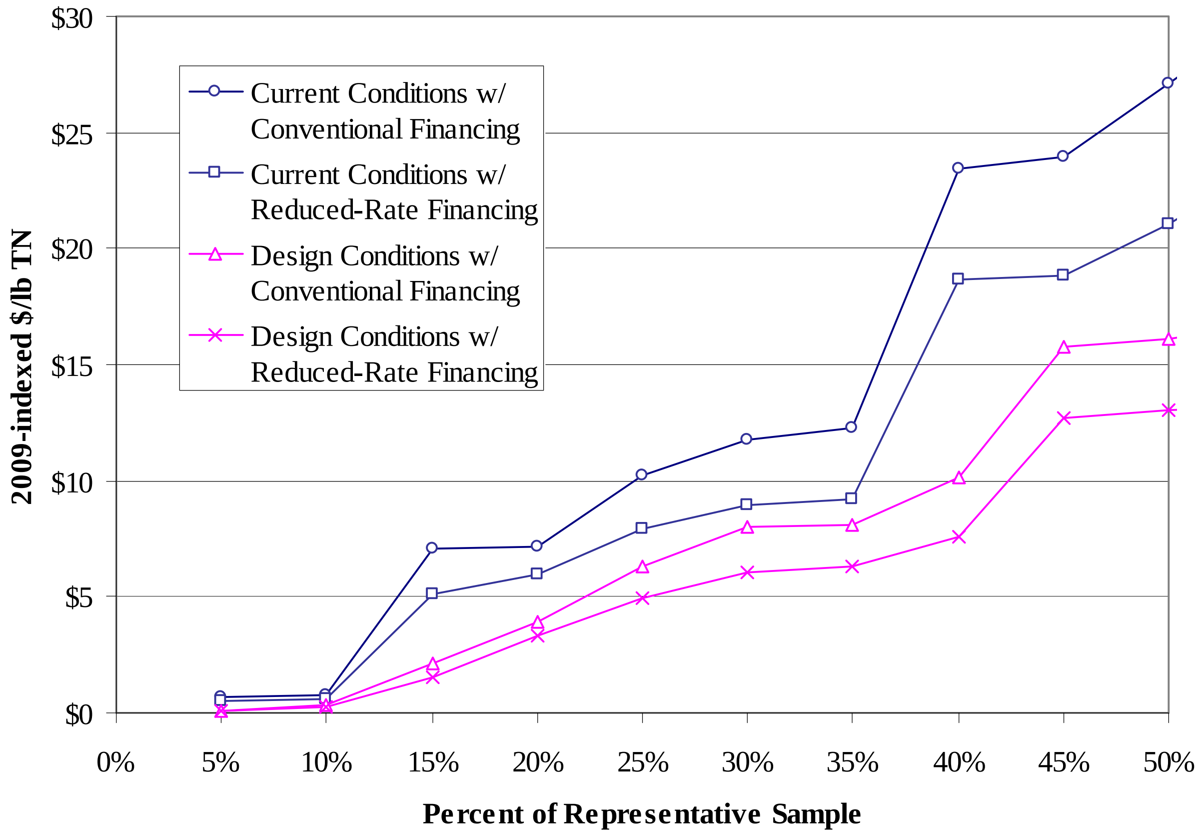


Figure 10.2
2009-Indexed Annual Cost for Nutrient-Related Upgrades versus Percentage of Representative Sample (Reduced Scale)



Figures 10.1 and 10.2 are useful in analyzing the annual cost of upgrades versus the cost of nutrient credits. For a discharger to have financial incentive to participate in nutrient trading, the price of nutrient credits must be below the annualized price for facility upgrades. The lines on Figs. 10.1 and 10.2 represent "break-even" lines. If the price of nutrient credits was below line, the discharger would have a financial incentive to consider nutrient trading.

By showing the break-even curves for current conditions (near-term) and design conditions (long-term), the near-term and long-term price points can be compared. Figures 10.1 and 10.2 show that in the near-term, dischargers whose current flow (and effluent TN load) is significantly less than design flow have a greater near-term financial incentive to trade. The figures also show that type of financing has a significant impact on the break-even value of nutrient credits. If a discharger expects to receive reduced-rate financing, such as a PENNVEST loan, the break-even value of nutrient credits drops.

Assuming that long-term decisions to use nutrient credits will be based on design conditions, Figure 10.1 shows that the upper 10% of the representative sample of dischargers had clear incentives to use nutrient credits. In fact, one of these facilities does plan to use nutrient credits as a long-term option. Looking at the lower 10% of the representative sample in Figure 10.2, it is clear that nutrient credits will not be the lowest cost for all dischargers, as nutrient credits would need to be well below $1/lb to be financially viable for all dischargers. Using Figure 10.2, and considering design conditions with reduced-rate financing, at a nutrient credit price of approximately $7.50/lb, nutrient credits could potentially be viable (on a strictly financial basis) for approximately 60% of the facilities in the representative sample, representing one-third of the total design flow.

This analysis only considers the break even point where credits would begin to become financially viable. The analysis does not consider cases where nutrient credits are not an option due to TMDL limits or municipal purchasing requirements. The analysis also does not consider transaction costs or the "intangible cost" associated with nutrient credits due to dischargers' uncertainties of market availability, market cost, and trading system structure.

10.6 References

Chesapeake Bay Program. 2008. Chesapeake Bay Phase 5 Community Watershed Model. Available at http://www.chesapeakebay.net/phase5.htm

Pennsylvania Department of Environmental Protection Water Planning Office. 2007. Red Barn Nutrient Trading Proposal for Client 0136. [Public Document Available Upon from PADEP upon Request]

U.S.D.A. National Agricultural Statistics Service. 2005. *2002 Census of Agriculture*. (Geographic Area Series 1C). Government Printing Office, Washington, DC. available at http://www.nass.usda.gov/Census_of_Agriculture/index.asp.

Wen Huang. 2007. USDA Economic Research Service. U.S. Fertilizer Use and Price. [Data Set]. Available at http://www.ers.usda.gov/Data/FertilizerUse/

11.0 POTENTIAL SOURCES OF FINANCIAL SUPPORT

11.1 Introduction

The following narrative attempts to briefly summarize historical and existing funding programs for the upgrading of sewage treatment plants (STPs) in Maryland and Virginia as part of the ongoing effort to restore the Chesapeake Bay. Later, potential funding sources for Pennsylvania dischargers are summarized.

11.2 Funding Programs in Maryland

Since 1984 Maryland has had a funding program dedicated towards upgrading wastewater treatment plants to employ BNR technology. In 2004, Maryland established the *Bay Restoration Fund (BRF)*[1] to provide state funding for the upgrade of STPs from Biological Nutrient Reduction (BNR) to Enhanced Nutrient Reduction (ENR) level technology. In addition, like Virginia, Maryland makes use of other financing options to help local governments meet the cost share requirements in the BRF and the existing BNR Program. A total of four programs have been established to fund STP upgrades in Maryland. They are:

- *ENR Program (ENRP) within the Bay Restoration Fund:* provides grants for up to 100% of the costs of planning, design and instillation of ENR technology in a significant STP. The fund was enacted in 2004 and is financed by wastewater treatment plant users[1].

- *Biological Nutrient Removal Program (BNRP):* provides 50-50 cost shares for the upgrade of the most significant STPs to BNR technology status. It was created in 1984 and has been used to help meet the original Chesapeake Bay Agreement of a 40% reduction in nutrients between 1987 and 2000. Between 1984 and 2004, a total of approximately $191 million has been authorized for this program[2].

- *Maryland Water Quality State Revolving Loan Fund (WQSRF):* makes below market rate loans (right now between 0.4% and 1.0%) to local governments for water quality improvement projects. It is financed 20% from state funds and the remainder from the EPA. BNR projects are usually cost shares at 50% and many local portions have been financed through the WQSRF[3].

- *Supplemental Assistance Program (SAP):* provides grant assistance for planning, design and construction of needed wastewater facilities when the project is of high public health or water quality importance and the local government has a limited ability to pay. Funded by allocations made by the Maryland General Assembly, it finances a small amount of the water quality projects in Maryland but is vitally important for many of the smaller and more rural communities in Maryland[4].

To fund the BNF program, Maryland has enacted a $2.50 per month restoration fee collected from each household and $2.50 per month per equivalent dwelling unit (EDU) is collected from each commercial and industrial user (1 EDU = 250 gallons of wastewater per day = wastewater effluent volume for the average household where an average of 2.5 persons live and create an average of 100 gallons of wastewater per person per day).

The BRF was initially estimated to generate approximately $60 million per year and is used to upgrade Maryland STPs, giving the 66 significant dischargers highest priority. In 2004 and 2005 $38.1 million was collected through the BRF while in 2006 collections exceeded expectations and $95.2 million was collected for the Wastewater Fund.

In 2004 it was estimated that between $0.75 and $1.00 billion will be needed in Maryland to upgrade all significant STPs to ENR level technology, coming mainly from the BRF Wastewater Fund. Between 2004 and 2010 the fund is expected to generate approximately $0.75 billion for this purpose[5]. Leveraging of the WQSRF and the SAP could allow for the fund to finance smaller cost share percentages and therefore to finance more projects overall.

11.3 Funding Programs in Virginia

In 1997, Virginia enacted the *Water Quality Improvement Act (WQIA)* which strives to reduce entry of nutrients into the Bay by providing technical and financial assistance through grants from the *Water Quality Improvement Fund (WQIF)*[6]. Grants for point source facilities (such as municipal sewage treatment plants) are administered by the Virginia Department of Environmental Quality (DEQ) and grants for non-point source facilities (such as agricultural land owners) are administered by the Virginia Department of Conservation and Recreation (DCR). When a grant agreement is created, facilities agree to pay fines if the facility cannot meet release limits as specified in the grant agreement.

Grants are created on a cost share basis which has historically been between approximately 35% and 75% of the cost of the project, depending on the ability of the local government and STP to fund the improvements[7]. The portion not covered by the state can be financed through a loan from the *Virginia Clean Water Revolving Loan Fund (VCWRLF)* which provides below market loans to local governments to assist in STP and wastewater collection system improvements. Use of the VCWRLF may prove instrumental in extending the reach and effectiveness of the WQIF by allowing the fund to finance smaller proportions of projects but more projects overall. However, the VCWRLF is dependent of federal appropriations which have been declining.

There have been dramatic increases in allocations to the WQIF in recent years which have allowed the funding of many new projects as well as the continued funding and completion of existing projects. Appropriation history of interest includes:

- From FY 2001 through FY 2004, no appropriations were made to the WQIF. Instead, accrued interest on previous appropriations was used (approximately $10.15 million over that time period). This lack of adequate funding resulted in a severe handicap to the program, forcing it to under fund previously approved, multi-year programs and preventing it from approving new grants. It was decided that, in January 2005, all deferred funds for 2002 and 2003 would be paid in a lump sum that would deplete the WQIF[8].

- For FY 2005, $13.3 million dollars in appropriations for the fund were made. $5.8 million was allocated to cover existing projects and fully pay the previously deferred costs. The remaining $7.5 million was allocated to fund grants for new nutrient reduction projects. While relatively small compared to future funding and the scope of STP improvements, the $13.3 million allowed the WQIF to remain solvent and viable[9]. In 2005 the *Nutrient Credit Exchange Association (NCEA)*[10] was created and is expected to reduce the overall cost to the WQIF of upgrading Virginia point sources by approximately 22% by creating a cap and trade system to encourage the market to solve wastewater treatment issues.

- For FY 2006, $67.21 million was appropriated in addition to $0.29 million interest earned from FY 2005. And for FY 2007-08, $212.80 million was appropriated with $1.57 million interest earned from FY 2006[11].

- It has been estimated that the total cost of instillation of ENR level technology in STPs in Virginia will be between $1.5 and $2.0 billion, which will cost the WQIF approximately $0.75 to $1.0 billion in cost shares[12]. The appropriations for FY 2007-08 are significant, but similar significant amounts will be needed in FY 2009 and 2010 to help meet the goals for nitrogen reduction by 2010.

11.4 Potential Funding Sources in Pennsylvania

The primary source of state funding for upgrading municipal sewage treatment plants is the Pennsylavnia Infrastructure Investment Authority (PennVEST) program. The PennVEST program, authorized by Act 16 of 1988, provides grants and a revolving pool of capital to rebuild and expand community drinking water systems and municipal sewage treatment facilities in the Commonwealth. Over the years, the program has been expanded to include stormwater control and brownfield remediation projects.

PennVEST funding comes from several sources, including bond issues approved by voter referendum, federal seed money, and tipping fee revenues. In particular, Act 218 of 2004 provided a one-time investment of $250 million for sewer and water infrastructure that included $50 million in grants for nutrient reduction technology installation and the elimination of combined sewer overflows. When the grant money was awarded, PennVEST provided a $50 million match plus $52 million in low-interest loans.

PennVEST anticipates awarding approximately $299 million in new loans and grants during FY 2008-2009. Of these amounts, approximately $60 million will be encumbered using the Commonwealth general obligation bonds and PennVEST recycled loan payments, with the balance coming from federally capitalized revolving loan funds. PennVEST will be encumbering most of these new loans and grants in outgoing fiscal years.

PennVEST anticipates the funding for these loans and grants will be allocated in the following manner:

	FY 2008-2009 ($ millions)
Public Water	64.0
Public Sewer	173.0
Brownfield	40.0
Public Storm Water	2.0
Private (total)	20.0
Total	299.0

Other funding sources for wastewater treatment facilities include approximately $5 million in Growing Greener Innovative Technology grants and Growing Greener II funds annually.

For the FY09 Pennsylvania budget, the legislature and Governor approved new statewide water infrastructure funding that will potentially offer $1.2 billion in grants and loans for water-related projects, if a $400 million bond issue referendum is approved in November 2008. It is anticipated that priority will be given to those proposals which seek to employ the grants and loans towards upgrading their facilities with NRT.

A potential source of funds at the federal level is the U.S. Department of Agriculture’s Rural Utilities Service (RUS), which funds water and wastewater projects. During the 2006 fiscal year, RUS distributed $1.5 billion in program funding—$1 billion in the form of low-interest loans and $500 million in grants—through its national network of rural development (RD) offices.

RUS program financing can be used for most costs related to the building or expansion of a water or wastewater project. These costs can include construction, legal expenses, engineering, and initial operating costs. RA community’s RUS loan is set at one of three rates—poverty, intermediate, and market rate—based on the community’s median income. Current loans are in the 4.125 to 4.5 percent range. RUS may also extend loans for up to 40 years, making the debt service payment more reasonable and affordable for the community.

11.5 Summary

Cumulatively, Maryland and Virginia have committed over $1.6 billion to help their STPs meet Clean Water Act mandates. Unlike Virginia and Maryland, Pennsylvania does not have a dedicated fund for the financing of STP upgrades. Because Pennsylvania does not have a funding source dedicated to installing nutrient removal technology at STPs and because the two funding sources commonly used, PENNVEST and Growing Greener, do not have internal funds dedicated specifically to that purpose, information about the amount of funds Pennsylvania has committed to nutrient removal at STPs is not readily available.

However, for the FY09 Pennsylvania budget, the legislature and Governor approved new statewide water infrastructure funding that offers $800 million in grants for water-related projects, and an additional $400 million for grants (aggregating no more than one-half of the $400 million) and loans, if a bond issue referendum is approved in November 2008. The $800 million program includes dam upgrades and flood control, specifically earmarking $135 million to such projects. For water and sewer projects, grants are limited to two-thirds of the project cost. At least 50% of the grants for water and sewer projects are reserved for projects that consolidate systems or are already regional. Priority is to be given to applicants subject to a court order/consent decree, or new permit requirements imposed after January 1, 2007; i.e., nutrient removal upgrades. Funding for the purchase of nutrient credit is expressly prohibited. With respect to the $400 million, if approved by the voters, funding will be more focused, being limited to water and sewer projects, and allows the use of funds for nutrient credit purchases.

11.6 References

[1] Maryland Water Quality State Revolving Loan Fund. Program summary. Available from: http://www.mde.state.md.us/programs/waterprograms/water_quality_finance/index.asp

[2] Biological Nutrient Removal Program. Program summary. Available from: http://www.mde.state.md.us/Programs/WaterPrograms/WQIP/wqip_bnr.asp

[3] Maryland Water Quality State Revolving Loan Fund. Program summary. Available from: http://www.mde.state.md.us/programs/waterprograms/water_quality_finance/index.asp

[4] Supplemental Assistance Program. Program summary. Available from: http://www.mde.state.md.us/programs/multimediaprograms/smart_growth/priorityfunding/sg_supplemental.asp

[5] Bay Restoration Fund: Annual Status Report. 2006 calendar year 2006, released January, 2007. Available from: http://www.mde.state.md.us/assets/document/BRF-AnnualStatusReport122206.pdf

[6] Virginia Water Quality Improvement Act of 1997 [WQIA]. Virginia Code §10.1-2117 through §10.1-2134. Complete text available from: http://leg1.state.va.us/cgi-bin/legp504.exe?971+ful+CHAP0625+pdf

[7] Water Quality Improvement Fund Annual Report [WQIF]. 2006 calendar year, released January 1, 2007. Available from: http://www.deq.state.va.us/regulations/pdf/2007WQIFAnnualReport.pdf

[8] Water Quality Improvement Fund Annual Report [WQIF]. 2003 calendar year, released January 1, 2004. Available from: http://www.deq.state.va.us/regulations/pdf/wqif2004.pdf

[9] Water Quality Improvement Fund Annual Report [WQIF]. 2004 calendar year, released January 2005. Available from: http://www.deq.state.va.us/regulations/pdf/2005WQIFAnnualReport.pdf

[10] Chesapeake Bay Watershed Nutrient Credit Exchange Program [NCEA]. Virginia Code §61.1-44.19:12 through 62.1-44.19:19. Complete text available from: http://leg1.state.va.us/cgi-bin/legp504.exe?051+ful+CHAP0710+pdf

[11] Water Quality Improvement Fund Annual Report [WQIF]. 2005 calendar year, released January 2006. Available from: http://www.deq.state.va.us/regulations/documents/2006WQIFAnnualReport.pdf

[12] Commonwealth of Virginia: Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. January, 2005. Available from: http://www.naturalresources.virginia.gov/Initiatives/WaterQuality/FinalizedTribStrats/ts_statewide_All.pdf

12.0 Response to This Report

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Office of Water Management

717-783-4693

Mr. Philip R. Durgin, Executive Director
Legislative Budget and Finance Committee
Room 400, Finance Building
P.O. Box 8737
Harrisburg, PA 17105-8737

Dear Mr. Durgin:

Thank you for the opportunity to review the October 24, 2008 Final Draft *Chesapeake Bay Tributary Strategy Compliance Cost Study*. The information developed through the effort will be useful in a variety of ways as we continue to implement the objectives of the tributary strategy.

One comment I wish to make concerns the subtle implication at the end of the Executive Summary that nutrient removal costs must be funded through government subsidies. The responsibility for wastewater treatment rests with the owners of discharging facilities. The quality of discharged wastewater effluent is controlled by federal and state law; the addition of a new feature to that quality of effluent does not change the responsibility. The report should therefore avoid promoting an expectation that communities can expect funding to meet new requirements. The first bullet at the end of the Executive Summary could therefore be amended to say "Funding provided in recent months is expected to assist some communities to meet the $1.40 billion cost."

The only other comment we have concerns the margin of error of approximately $0.14 billion which is associated with the nutrient removal capital cost estimate of $1.40 billion. It appears that the margin of error may in reality be greater.

The study uses capital needs data from the 67 facilities which responded to the survey to estimate the capital needs at the 116 facilities that did not respond to the survey. The application of a predictive equation to the 116 facilities results in costs of 0.71 billion, approximately 0.14 billion (see Appendix J). The variation of $0.14 billion (0.14 / 0.71 = 19.7 percent) is characterized as the only source of error for the entire group of 183 facilities.

What that analysis fails to consider is the uncertainty of the costs provided by the 67 communities. Interestingly, the report discusses this type of error on page 11, suggesting that "budget estimate" error is typically -15 percent to +30 percent, and that much of the data provided by the 67 facilities is of this quality because of the status of facility planning. It does not appear however that this information was included in the assessment of overall potential error. It may therefore be appropriate to apply approximately a -15 percent to +30 percent errors to the costs from the 67 communities. For the 116 non-respondents, you may wish to use both the -15 percent to +30 percent error as well as the +/- 19.7 percent error from the use of the predictive equation.

Additional detailed comments are provided in the attached document. Again, thank you for the opportunity to review and comment. Should you have any questions or concerns, feel free to contact Marcus Kohl of my staff by telephone at 717-783-7407 or by e-mail at mkohl@state.pa.us.

Sincerely,

Cathy Curran Myers

Cathy Curran Myers
Deputy Secretary for
Office of Water Management

Comments on the CBTS Compliance Cost Study

Overall Comments:

- The referenced appendices were not included in this version of the study so no review could be completed.

Specific Comments:

- Page 3, third paragraph: It should be corrected that only 5 trades have been recorded.
- Page 28: The summary of point source discharger telephone survey results seem to be repetitive and could be summarized into fewer bullets or could be described similar to what was done in the summary of the opinion survey.
- Page 29, second paragraph: It states 2 themes were expressed but then it discusses what appear to be 3 themes.
- Page 29, second bullet: There is a word missing. "This trade involved **the** purchase of nutrient credits for fifteen (15) years starting in 2010."
- Page 29, Non Point to Point Source Discharger Trades subsection: It is interesting to note that there is no discussion on costs of the trades but highlights all other aspects of the trade.
- Page 30, first paragraph: Would suggest rewording the last sentence to avoid terminology confusion. Suggested edit: "Although the list of factors relates primarily to dischargers purchasing nutrient credits from non-point sources (NPS) to use towards achieving compliance with NPDES effluent limits, it is useful for Dischargers when considering point source to point source trades as well."
- Page 30-32- It seems like the "list of factors" contains a description, survey and interview finding(s) and in some a recommendation to address the factor. It should be clear what is being described, why and if appropriate state how the factor could be addressed. This comment gets to the uniformity and clarity of the study, findings and recommendations.
- Page 34, second paragraph: The word dischargers should be removed after non-point source so that the sentence would read "Nutrient Trading between Dischargers such as wastewater treatment plants and non-point sources (NPS) such as farms is a key goal of the PANTP." The deletion of the word may ease confusion as it relates to the term "dischargers" since that has been highlighted in the beginning to be "municipal wastewater (point sources) dischargers to the Ch. Bay watershed (Dischargers)".
    - This comment also refers back to one of the overall comments that was provided as it relates to abbreviations and terminology. It should remain consistent throughout the document or section to be clear. Note, this is just one of many instances that this occurs.
- Page 34, third paragraph, second sentence: It is suggested that the tense of a word be changed from "come" to "came".

- Page 34, fourth paragraph: Suggesting that the paragraph may be easier to read if it were broken down into bullets providing the descriptions of each table.
- Page 35, first paragraph: It is not discussed but interesting to point out that perhaps part of the financial incentive be developed through the demand for credits.
- Page 35-43: Due to the time constraint staff will not provide comment on the specific values that were used and determined by the study to estimate potential credits. However, comments have been provided on the general description.
- Page 35, Potential Credit Generation of Nutrient Trading Credits sub-section: In the previous comments it was suggested that the study discuss or clarify the estimates that are determined through this study as compared to the "Tradable Load" determined by the PADEP to avoid confusion. The study now includes this information but it is set in a manner that is confusing in regards to which estimates are referenced etc. It is suggested that this section be revised to articulate which are the study estimates and how those compare to what the department has determined.
- Page 35, third paragraph: The reference to the tradable load document is incorrect. The document can be found at the following location: http://www.dep.state.pa.us/river/Nutrient%20Trading_files/PA%20Tradable%20Load.pdf.
- Page 35, third paragraph: It is suggested that the paragraph be corrected to match the PADEP description of the tradable load.
- Page 35, fifth paragraph: The reference location for the fact sheet should be provided.
  - This comment references back to the consistency in how documents are referenced throughout the section.
- Page 35, fifth paragraph: Due to the time constraint staff was not able to determine if the values listed as being obtained from the DEP data management section are correctly referenced.
- Page 37, first section of bullet #5: It should be referenced correctly that the calculation template is from a proposal that Red Barn Trading Company had submitted.
- Page 37, second section of bullets #6 and last sentence: The reference to the calculation spreadsheets is incorrect, it should be: http://www.dep.state.pa.us/river/Nutrient%20Trading.htm#Calculation.
- Page 38, second paragraph: It should be better defined on the trading program website, but the water control structure BMP as defined by the Ch. Bay Program and Model is not applicable in PA. Currently it states on the website " Note: these spreadsheets may be updated and corrected as needed, so please check this website or contact DEP to ensure you are using the most up-to-date version. In addition, at this time, these spreadsheets should not be used to calculate reductions generated from the carbon sequestration BMP and the water control structure BMP. "

- Page 43, #21: It should be referenced correctly that the calculation template is from a proposal that Red Barn Trading Company had submitted.
- Page 46-47, Assessment of Viability of Trading Program sub-section: It appears that a lot of good points are highlighted in this sub-section but they seem to get lost in the discussion and it might be helpful to structure the assessment in a manner that each issue is described clearly with an overall recommendation to be provided at the end. As written many of the points, run together and multiple suggestions are made but not in one concluding effort.
- Page 47 is printed twice.
- Page 47, Average Price for Nutrient Trades sub-section: This sub-section is hard to follow and it may be best to consider revising. It may be easier to follow by discussing exactly what is to be determined by table 10-5 and then provide the summary of where the information in the table came from and provide a concluding point.
- Page 47, fourth paragraph: The information should correctly reference the activities that have been completed. Specifically, there have been five (5) N trades to date, and two (2) P trades.
    - There have been no trades made for N in the $4 range for the amounts listed (7,834 and 146). These credit amounts were posted by PACD on NutrientNet to be available for sale but no sale or trade of these credits has occurred. This information is helpful, however in determining a potential market price.
- Page 48, Table 10-5: A footnote or description should be provided on how the $6.20 price/credit was determined for the 20,000 N credits. The table should also be revised to reflect the previous comment provided related to the $4 price of credits.
- Page 51, References: There appear to be more documents referenced in section 10 then are listed in the reference section (10.6).

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60044954/202

November 20, 2008 **Via Electronic Mail**

Mr. Philip Durgin
Executive Director
Legislative Budget & Finance Committee
400-A Finance Building
Commonwealth and North Streets
Harrisburg, PA 17105

Dear Mr. Durgin:

Thank you for sharing the comments by PADEP Office of Water Management on the Final Draft of the Chesapeake Bay Tributary Strategy Compliance Cost Study, dated October 24, 2008. These comments (undated) were forwarded to Metcalf & Eddy on November 19, 2008. As such, we were not able to address the comments prior to submittal of the "reproduction-ready" report dated November 2008. However, we offer this letter as a response to PADEP comments for inclusion in the final bound report package that will be submitted to the Committee. We present PADEP's comments in italics and offer our comments in bracketed upper case font as follows:

> *One comment I wish to make concerns the subtle implication at the end of the Executive Summary that nutrient removal costs must be funded through government subsidies. The responsibility for wastewater treatment rests with the owners of discharging facilities. The quality of discharged wastewater effluent is controlled by federal and state law; the addition of a new feature to that quality of effluent does not change the responsibility. The report should therefore avoid promoting an expectation that communities can expect funding to meet new requirements. The first bullet at the end of the Executive Summary could therefore be amended to say "Funding provided in recent months is expected to assist some communities to meet the $1.40 billion cost."* [THIS APPEARS TO BE A REFERENCE TO THE USE OF THE WORD 'UNDERFUNDED'. CURRENT FUNDING WAS CREATED WHEN NUTRIENT-RELATED COST ESTIMATES AS LOW AS $190 MILLION WERE PROPOSED. IF THE LEGISLATIVE INTENT OF RECENT FUNDING WAS TO PROVIDE FUNDS COMMENSURATE WITH NEED, THEN 'UNDERFUNDED' IS ACCURATE, IN LIGHT OF THE REFINED NUTRIENT-RELATED COST ESTIMATE OF $1.40 BILLION WE NOW HAVE. FUNDING IS A LEGISLATIVE DECISION, OF COURSE. IT'S UP TO THE LEGISLATURE TO DECIDE WHETHER THE STATE WILL 'ASSIST' OR FULLY FUND.]
>
> *The only other comment we have concerns the margin of error of +/- $0.14 billion which is associated with the nutrient removal capital cost estimate of $1.40 billion. It appears that the margin of error may in reality be greater.* [SEE EXPLANATION BELOW.]
>
> *The study uses capital needs data from the 67 facilities which responded to the survey to estimate the capital needs at the 116 facilities that did not respond to the survey. The application of a predictive equation to the 116 facilities results in costs of 0.71 billion, +/- 0.14 billion (see*

Appendix J). The variation of $0.14 billion (0.14 / 0.71 = 19.7%) is characterized as the only source of error for the entire group of 183 facilities. [THIS VARIATION IS THE MOST SIGNIFICANT AND STATISTICALLY QUANTIFIABLE SOURCE OF ERROR].

What that analysis fails to consider is the uncertainty of the costs provided by the 67 communities. Interestingly the report discusses this type of error on page 11, suggesting that "budget estimate" error is typically -15% to +30%, and that much of the data provided by the 67 facilities is of this quality because of the status of facility planning. It does not appear however that this information was included in the assessment of overall potential error. [CORRECT]. *It may therefore be appropriate to apply approximately a -15% to +30% error to the costs from the 67 communities. For the 116 non-respondents, you may wish to use both the -15% to +30% error as well as the +/- 19.7% error from the use of the predictive equation.* [APPLYING A -15% TO +30% MARGIN OF ERROR TO THE SUMMATION OF REPORTED COSTS WOULD BE INAPPROPRIATE. ALTHOUGH AN INDIVIDUAL FACILITY REPORTING COSTS MAY HAVE A -15% TO +30% MARGIN OF ERROR ASSOCITED WITH ITS INDIVIDUAL COST ESTIMATE, WHEN SUMMING ESTIMATES FOR THE BODY OF RESPONDENTS THE 'PLUSSES' AND 'MINUSES' ASSOCIATED WITH MARGINS OF ERROR FOR INDIVUDUAL COST ESTIMATES DO TEND TO AVERAGE EACH OTHER OUT. THEREFORE, THE MARGIN OF ERROR FOR THE BODY OF RESPONDENTS IS EXPECTED TO BE MUCH SMALLER THAN THE -15% TO +30% INTERVAL SUGGESTED. NOTE THAT THE EXPECTED MARGIN OF ERROR FOR PRELIMIARY ESTIMATES IS ASSYMETRICAL AND SKEWED AND IS CHARACTERIZED BY AN ADDITIONAL 15 PERCENTAGE POINTS TOWARDS HIGHER-THAN-REPORTED COST. THIS BIAS WOULD OVERSHADOW THE MARGIN OF ERROR FOR THE ESTIMATE FOR THE BODY RESPONDENTS. THE BIAS WAS IGNORED, GIVING A CONSERVATIVELY LOW-END COST ESTIMATE].

Should you have any questions or comments as you review the report, please feel free to call me.

Sincerely,
METCALF & EDDY, INC.

Ralph Eschborn
Senior Project Manager

APPENDIX A

Alternate Allocation Strategy Table
from DEP Chesapeake Bay Steering Committee's
Alternative Wasteload Allocation Proposal
dated June 28, 2006

Facility Name	County	Annual Avge Design Flow	Projected 2010 Flow	Current Trib Strategy TN Cap Load at 2010 Flow @8 mg/l	Resulting TN Level at Design Flow Under Current Trib Strategy	Alternate TN Cap Loading at Design Flow @6 mg/l	Current Trib Strategy TP Cap Load at 2010 Flow @1 mg/l	Resulting TP Level at Design Flow Under Current Trib Strategy	Alternate TP Cap Loading at Design Flow @0.8 mg/l
HARRISBURG AUTHORITY	Dauphin	37.700	30.300	**737,890**	6.4	**688,575**	**92,236**	0.80	**91,810**
LANCASTER CITY	Lancaster	32.080	25.420	**619,048**	6.3	**585,928**	**77,381**	0.79	**78,124**
YORK CITY SEW AUTH	York	26.000	13.676	**333,049**	4.2	**474,880**	**41,631**	0.53	**63,317**
SCRANTON CITY SEW AUTH	Lackawanna	20.000	14.100	**343,374**	5.6	**365,292**	**42,922**	0.71	**48,706**
WYOMING VALLEY SAN AUTH	Luzerne	32.000	27.200	**662,396**	6.8	**584,467**	**82,800**	0.85	**77,929**
WILLIAMSPORT SAN AUTH-CENTRAL	Lycoming	8.400	8.385	**204,198**	8.0	**153,423**	**25,525**	1.00	**20,456**
LANCASTER AREA SEW AUTH	Lancaster	15.000	9.500	**231,352**	5.1	**273,969**	**28,919**	0.63	**36,529**
LEBANON CITY	Lebanon	8.000	6.050	**147,334**	6.1	**146,117**	**18,417**	0.76	**19,482**
GREATER HAZELTON JNT SEW AUTH	Luzerne	8.900	8.900	**216,740**	8.0	**162,555**	**27,092**	1.00	**21,674**
SPRINGETTSBURY TWP	York	15.000	14.813	**360,738**	7.9	**273,969**	**45,092**	0.99	**36,529**
CARLISLE BORO	Cumberland	7.000	4.390	**106,909**	5.0	**127,852**	**13,364**	0.63	**17,047**
LACKAWANNA RIVER BASIN SEW AUT (THROOP)	Lackawanna	7.000	7.000	**170,470**	8.0	**127,852**	**21,309**	1.00	**17,047**
WILLIAMSPORT SAN AUTH-WEST	Lycoming	3.920	3.610	**87,914**	7.4	**71,597**	**10,989**	0.92	**9,546**
UNIVERSITY AREA JOINT AUTH -	Centre	9.000	5.301	**129,094**	4.7	**164,381**	**16,137**	0.59	**21,918**
SWATARA TWP AUTH	Dauphin	6.300	4.264	**103,840**	5.4	**115,067**	**12,980**	0.68	**15,342**
DERRY TWP MUN AUTH - CLEARWATER	Dauphin	5.020	4.270	**103,986**	6.8	**91,688**	**12,998**	0.85	**12,225**
TYRONE BORO	Blair	9.000	6.400	**155,858**	5.7	**164,381**	**19,482**	0.71	**21,918**
ALTOONA CITY AUTH - EAST	Blair	8.000	6.022	**146,653**	6.0	**146,117**	**18,332**	0.75	**19,482**
LITITZ SEW AUTH	Lancaster	3.850	2.970	**72,328**	6.2	**70,319**	**9,041**	0.77	**9,376**
ALTOONA CITY AUTH - WEST	Blair	9.000	6.254	**152,302**	5.6	**164,381**	**19,038**	0.69	**21,918**
LOCK HAVEN CITY	Clinton	3.750	2.339	**56,961**	5.0	**68,492**	**7,120**	0.62	**9,132**
BLOOMSBURG TWP MUN AUTH	Columbia	4.290	2.834	**69,016**	5.3	**78,355**	**8,627**	0.66	**10,447**
SHAMOKIN-COAL TWP JNT SEW AUTH	Northumberland	7.000	4.524	**110,172**	5.2	**127,852**	**13,772**	0.65	**17,047**
HANOVER BOROUGH	York	5.500	4.299	**104,693**	6.3	**100,455**	**13,087**	0.78	**13,394**
SHIPPENSBURG BORO	Franklin	3.300	2.170	**52,846**	5.3	**60,273**	**6,606**	0.66	**8,036**
LOWER ALLEN TWP AUTH	Cumberland	6.250	3.970	**96,681**	5.1	**114,154**	**12,085**	0.64	**15,221**
LOWER LACKAWANNA VLY SAN AUTH	Luzerne	6.000	3.910	**95,219**	5.2	**109,588**	**11,902**	0.65	**14,612**
MANHEIM STP	Lancaster	1.140	1.370	**33,363**	9.6	**20,822**	**4,170**	1.20	**2,776**
CLARKS SUMMIT - S ABINGTON JSA	Lackawanna	2.500	2.730	**66,483**	8.7	**45,662**	**8,310**	1.09	**6,088**
EPHRATA BORO AUTH #2	Lancaster	2.300	2.240	**54,550**	7.8	**42,009**	**6,819**	0.97	**5,601**
LEWISBURG AREA JOINT SEW AUTH	Union	2.420	1.326	**32,292**	4.4	**44,200**	**4,036**	0.55	**5,893**
EPHRATA BORO AUTH	Lancaster	3.800	3.246	**79,049**	6.8	**69,405**	**9,881**	0.85	**9,254**
DOVER TWP	York	8.000	4.431	**107,907**	4.4	**146,117**	**13,488**	0.55	**19,482**
LEMOYNE BORO	Cumberland	2.088	1.740	**42,374**	6.7	**38,136**	**5,297**	0.83	**5,085**
EAST PENNSBORO TWP	Cumberland	3.700	2.470	**60,151**	5.3	**67,579**	**7,519**	0.67	**9,011**
MONTGOMERY WATER & SEWER AUTH	Lycoming	0.850	0.676	**16,462**	6.4	**15,525**	**2,058**	0.80	**2,070**
CHAMBERSBURG BORO	Franklin	6.800	5.300	**129,070**	6.2	**124,199**	**16,134**	0.78	**16,560**
HUNTINGDON BORO	Huntingdon	4.000	2.667	**64,949**	5.3	**73,058**	**8,119**	0.67	**9,741**
MOUNT JOY BORO AUTH	Lancaster	1.530	1.200	**29,223**	6.3	**27,945**	**3,653**	0.78	**3,726**
BEDFORD BORO MUN AUTH	Bedford	1.500	0.980	**23,866**	5.2	**27,397**	**2,983**	0.65	**3,653**
MECHANICSBURG BORO	Cumberland	2.080	1.440	**35,068**	5.5	**37,990**	**4,384**	0.69	**5,065**
HIGHSPIRE BORO	Dauphin	2.000	1.280	**31,172**	5.1	**36,529**	**3,896**	0.64	**4,871**

Facility Name	County	Annual Avge Design Flow	Projected 2010 Flow	Current Trib Strategy TN Cap Load at 2010 Flow @8 mg/l	Resulting TN Level at Design Flow Under Current Trib Strategy	Alternate TN Cap Loading at Design Flow @6 mg/l	Current Trib Strategy TP Cap Load at 2010 Flow @1 mg/l	Resulting TP Level at Design Flow Under Current Trib Strategy	Alternate TP Cap Loading at Design Flow @0.8 mg/l
BERWICK AREA JNT SEW AUTH	Columbia	3.660	2.343	**57,059**	5.1	**66,848**	**7,132**	0.64	**8,913**
DILLSBURG AREA AUTH	York	1.530	0.853	**20,773**	4.5	**27,945**	**2,597**	0.56	**3,726**
HAMPDEN TWP - ROTH LANE	Cumberland	4.820	2.760	**67,214**	4.6	**88,035**	**8,402**	0.57	**11,738**
NORTHEASTERN YORK CO SEW AUTH	York	1.700	0.984	**23,963**	4.6	**31,050**	**2,995**	0.58	**4,140**
PALMYRA BORO STP	Lebanon	1.420	1.030	**25,083**	5.8	**25,936**	**3,135**	0.73	**3,458**
MIDDLETOWN BORO AUTH	Dauphin	2.200	1.500	**36,529**	5.5	**40,182**	**4,566**	0.68	**5,358**
FRACKVILLE AREA MA	Schuylkill	1.400	1.150	**28,006**	6.6	**25,570**	**3,501**	0.82	**3,409**
CLEARFIELD MUN AUTH	Clearfield	4.500	2.895	**70,501**	5.1	**82,191**	**8,813**	0.64	**10,959**
WELLSBORO MUN AUTH	Tioga	2.000	1.492	**36,334**	6.0	**36,529**	**4,542**	0.75	**4,871**
MOUNTAINTOP AREA JNT SAN AUTH	Luzerne	4.160	3.300	**80,364**	6.3	**75,981**	**10,046**	0.79	**10,131**
FT INDIANTOWN GAP	Lebanon	1.000	1.000	**24,353**	8.0	**18,265**	**3,044**	1.00	**2,435**
BELLEFONTE BORO	Centre	3.220	2.410	**58,690**	6.0	**58,812**	**7,336**	0.75	**7,842**
PENN TWP BOARD OF COMMISSIONER	York	4.200	2.329	**56,718**	4.4	**76,711**	**7,090**	0.55	**10,228**
LEWISTOWN BORO	Mifflin	2.818	1.820	**44,322**	5.2	**51,470**	**5,540**	0.65	**6,863**
EASTERN SNYDER CO REG AUTH	Snyder	2.800	1.817	**44,249**	5.2	**51,141**	**5,531**	0.65	**6,819**
SUNBURY CITY MUN AUTH	Northumberland	4.200	3.995	**97,289**	7.6	**76,711**	**12,161**	0.95	**10,228**
FAIRVIEW TWP	York	0.730	0.454	**11,056**	5.0	**13,333**	**1,382**	0.62	**1,778**
DANVILLE BORO	Montour	3.620	2.205	**53,698**	4.9	**66,118**	**6,712**	0.61	**8,816**
NEW OXFORD MUN AUTH	Adams	2.680	1.350	**32,876**	4.0	**48,949**	**4,110**	0.50	**6,527**
NEW HOLLAND BORO	Lancaster	1.340	1.080	**26,301**	6.4	**24,475**	**3,288**	0.81	**3,263**
ELIZABETHTOWN BORO	Lancaster	4.500	2.720	**66,240**	4.8	**82,191**	**8,280**	0.60	**10,959**
JERSEY SHORE BORO	Lycoming	1.050	0.750	**18,265**	5.7	**19,178**	**2,283**	0.71	**2,557**
LACKAWANNA RIVER BASIN SEW AUT (ARCHBALD)	Lackawanna	6.000	3.500	**85,235**	4.7	**109,588**	**10,654**	0.58	**14,612**
HAMPDEN TWP - PINEBROOK	Cumberland	1.760	1.300	**31,659**	5.9	**32,146**	**3,957**	0.74	**4,286**
COLUMBIA MUN AUTH	Lancaster	2.000	0.830	**20,213**	3.3	**36,529**	**2,527**	0.42	**4,871**
LYCOMING CO WATER & SEWER AUTH	Lycoming	1.500	0.795	**19,360**	4.2	**27,397**	**2,420**	0.53	**3,653**
MARIETTA-DONEGAL JOINT AUTH	Lancaster	0.750	0.510	**12,420**	5.4	**13,698**	**1,552**	0.68	**1,826**
WEST HANOVER	Dauphin	0.780	0.663	**16,146**	6.8	**14,246**	**2,018**	0.85	**1,900**
MID-CENTRE COUNTY AUTH	Centre	1.000	0.712	**17,339**	5.7	**18,265**	**2,167**	0.71	**2,435**
MOSHANNON VALLEY JT SEW AUTH	Centre	1.732	1.925	**46,879**	8.9	**31,634**	**5,860**	1.11	**4,218**
SOUTH MIDDLETON TWP MUN AUTH	Cumberland	1.500	0.550	**13,394**	2.9	**27,397**	**1,674**	0.37	**3,653**
NORTHWESTERN LANCASTER CNTY AUTH	Lancaster	0.650	0.600	**14,612**	7.4	**11,872**	**1,826**	0.92	**1,583**
MOUNT CARMEL MUN AUTH	Northumberland	1.500	1.041	**25,351**	5.6	**27,397**	**3,169**	0.69	**3,653**
ANNVILLE TWP	Lebanon	0.750	0.600	**14,612**	6.4	**13,698**	**1,826**	0.80	**1,826**
DUNCANNON BORO	Perry	0.740	0.585	**14,246**	6.3	**13,516**	**1,781**	0.79	**1,802**
WAYNESBORO BORO AUTH	Franklin	1.600	0.900	**21,918**	4.5	**29,223**	**2,740**	0.56	**3,896**
MUNCY BORO MUN AUTH	Lycoming	1.400	1.224	**29,808**	7.0	**25,570**	**3,726**	0.87	**3,409**
WEST BRANCH SA	Cambria	0.900	0.690	**16,803**	6.1	**16,438**	**2,100**	0.77	**2,192**
PINE GROVE JOINT SEWER AUTHORITY	Schuylkill	1.500	0.640	**15,586**	3.4	**27,397**	**1,948**	0.43	**3,653**
NEW CUMBERLAND BORO	Cumberland	1.250	0.490	**11,933**	3.1	**22,831**	**1,492**	0.39	**3,044**
SCHUYLKILL CO MA	Schuylkill	0.600	0.550	**13,394**	7.3	**10,959**	**1,674**	0.92	**1,461**
NORTH CODORUS TWP	York	0.550	0.550	**13,394**	8.0	**10,046**	**1,674**	1.00	**1,339**
DUNCANSVILLE BORO	Blair	1.217	0.718	**17,485**	4.7	**22,228**	**2,186**	0.59	**2,964**

Facility Name	County	Annual Avge Design Flow	Projected 2010 Flow	Current Trib Strategy TN Cap Load at 2010 Flow @8 mg/l	Resulting TN Level at Design Flow Under Current Trib Strategy	Alternate TN Cap Loading at Design Flow @6 mg/l	Current Trib Strategy TP Cap Load at 2010 Flow @1 mg/l	Resulting TP Level at Design Flow Under Current Trib Strategy	Alternate TP Cap Loading at Design Flow @0.8 mg/l
MIDDLEBURG MUN AUTH	Snyder	0.450	0.540	**13,151**	9.6	**8,219**	**1,644**	1.20	**1,096**
SALISBURY TWP	Lancaster	0.580	0.540	**13,151**	7.4	**10,593**	**1,644**	0.93	**1,412**
PINE CREEK MUN AUTH	Clinton	1.300	0.802	**19,531**	4.9	**23,744**	**2,441**	0.62	**3,166**
GRANVILLE TWP	Mifflin	0.500	0.624	**15,196**	10.0	**9,132**	**1,900**	1.25	**1,218**
TOWANDA MUN AUTH	Bradford	1.160	0.911	**22,185**	6.3	**21,187**	**2,773**	0.79	**2,825**
HOLLIDAYSBURG REGIONAL SEW AUTH	Blair	6.000	3.568	**86,891**	4.8	**109,588**	**10,861**	0.59	**14,612**
NEWBERRY TWP MUN AUTH	York	1.300	0.531	**12,931**	3.3	**23,744**	**1,616**	0.41	**3,166**
KBM REGIONAL AUTH	Carbon	0.700	0.560	**13,638**	6.4	**12,785**	**1,705**	0.80	**1,705**
KELLY TWP MUN AUTH	Union	3.750	1.758	**42,812**	3.8	**68,492**	**5,352**	0.47	**9,132**
FAIRVIEW TWP AUTHORITY	York	0.500	0.464	**11,300**	7.4	**9,132**	**1,412**	0.93	**1,218**
MILTON REGIONAL SEW AUTH	Northumberland	3.420	2.388	**58,154**	5.6	**62,465**	**7,269**	0.70	**8,329**
GREENFIELD TWP MUN AUTH	Blair	0.800	0.541	**13,175**	5.4	**14,612**	**1,647**	0.68	**1,948**
GREENCASTLE FRANKLIN CO AUTH	Franklin	0.800	0.600	**14,612**	6.0	**14,612**	**1,826**	0.75	**1,948**
NEW MORGAN STP	Berks	0.500	0.500	**12,176**	8.0	**9,132**	**1,522**	1.00	**1,218**
MONTROSE MA	Susquehanna	0.820	0.600	**14,612**	5.9	**14,977**	**1,826**	0.73	**1,997**
NORTH MIDDLETON AUTH	Cumberland	0.925	0.846	**20,602**	7.3	**16,895**	**2,575**	0.91	**2,253**
GLEN ROCK SEW AUTH	York	0.600	0.433	**10,545**	5.8	**10,959**	**1,318**	0.72	**1,461**
RALPHO TWP MUN AUTH	Northumberland	0.719	0.502	**12,225**	5.6	**13,132**	**1,528**	0.70	**1,751**
EASTERN YORK COUNTY SEWER AUTH	York	0.600	0.418	**10,179**	5.6	**10,959**	**1,272**	0.70	**1,461**
CAERNARVON TWP STP	Berks	0.700	0.470	**11,446**	5.4	**12,785**	**1,431**	0.67	**1,705**
TWIN BOROUGHS SANITARY AUTH	Juniata	0.900	0.720	**17,534**	6.4	**16,438**	**2,192**	0.80	**2,192**
ADAMSTOWN BORO AUTH OF LANCAST	Lancaster	0.600	0.460	**11,202**	6.1	**10,959**	**1,400**	0.77	**1,461**
DERRY TWP MUN AUTH - SOUTHWEST	Dauphin	0.600	0.400	**9,741**	5.3	**10,959**	**1,218**	0.67	**1,461**
DOVER BORO	York	0.400	0.400	**9,741**	8.0	**7,306**	**1,218**	1.00	**974**
NEWPORT BORO MUN AUTH	Perry	0.400	0.400	**9,741**	8.0	**7,306**	**1,218**	1.00	**974**
NORTHERN LEBANON CO AUTH	Lebanon	0.400	0.400	**9,741**	8.0	**7,306**	**1,218**	1.00	**974**
WRIGHTSVILLE BORO MUN AUTH	York	0.400	0.400	**9,741**	8.0	**7,306**	**1,218**	1.00	**974**
TROY BORO	Bradford	0.400	0.400	**9,741**	8.0	**7,306**	**1,218**	1.00	**974**
QUARRYVILLE STP	Lancaster	0.400	0.400	**9,741**	8.0	**7,306**	**1,218**	1.00	**974**
CONEWAGO TWP SEW AUTH	York	0.500	0.400	**9,741**	6.4	**9,132**	**1,218**	0.80	**1,218**
SPRINGFIELD TWP SEW AUTH - HOL	York	0.700	0.400	**9,741**	4.6	**12,785**	**1,218**	0.57	**1,705**
LOWER PAXTON WET WEATHER STP	Dauphin	2.500	0.400	**9,741**	1.3	**45,662**	**1,218**	0.16	**6,088**
FREEDOM TOWNSHIP WATER&SEWER AUTHORITY	Blair	0.600	0.461	**11,227**	6.1	**10,959**	**1,403**	0.77	**1,461**
TREMONT MUNICIPAL AUTHORITY	Schuylkill	0.500	0.388	**9,741**	6.2	**9,132**	**1,181**	0.78	**1,218**
DALLAS SCI	Luzerne	0.450	0.450	**10,959**	8.0	**8,219**	**1,370**	1.00	**1,096**
SHENANDOAH MUN SEW AUTH	Schuylkill	2.000	1.630	**39,695**	6.5	**36,529**	**4,962**	0.82	**4,871**
STEWARTSTOWN BORO	York	0.740	0.441	**10,740**	4.8	**13,516**	**1,342**	0.60	**1,802**
DEFENSE DISTRIBUTION DEPOT SUSQUEHANNA	York	0.500	0.375	**9,741**	6.0	**9,132**	**1,142**	0.75	**1,218**
HUGHESVILLE-WOLF TWP JOINT SEW	Lycoming	0.675	0.381	**9,741**	4.5	**12,329**	**1,160**	0.56	**1,644**
NORTHUMBERLAND SEW AUTH	Northumberland	1.125	0.520	**12,663**	3.7	**20,548**	**1,583**	0.46	**2,740**
MIFFLINBURG BORO	Union	1.400	0.819	**19,945**	4.7	**25,570**	**2,493**	0.59	**3,409**
GALLITZIN BORO	Cambria	0.400	0.450	**10,959**	9.0	**7,306**	**1,370**	1.13	**974**
BUTLER TWP MUN AUTH (ST JOHNS)	Luzerne	2.200	0.740	**18,021**	2.7	**40,182**	**2,253**	0.34	**5,358**

Facility Name	County	Annual Avge Design Flow	Projected 2010 Flow	Current Trib Strategy TN Cap Load at 2010 Flow @8 mg/l	Resulting TN Level at Design Flow Under Current Trib Strategy	Alternate TN Cap Loading at Design Flow @6 mg/l	Current Trib Strategy TP Cap Load at 2010 Flow @1 mg/l	Resulting TP Level at Design Flow Under Current Trib Strategy	Alternate TP Cap Loading at Design Flow @0.8 mg/l
NORTHERN LANCASTER CO AUTH	Lancaster	0.450	0.400	**9,741**	7.1	**8,219**	**1,218**	0.89	**1,096**
SAXTON BORO MUN AUTH	Bedford	0.400	0.413	**10,058**	8.3	**7,306**	**1,257**	1.03	**974**
WASHINGTON TWP MUN AUTH	Franklin	1.940	1.250	**30,441**	5.2	**35,433**	**3,805**	0.64	**4,724**
KULPMONT-MARION HEIGHTS JT MUN	Northumberland	0.500	0.400	**9,741**	6.4	**9,132**	**1,218**	0.80	**1,218**
EVERETT BORO AREA MA	Bedford	0.870	0.400	**9,741**	3.7	**15,890**	**1,218**	0.46	**2,119**
CHESTNUT RIDGE AREA JMA	Bedford	0.705	0.400	**9,741**	4.5	**12,877**	**1,218**	0.57	**1,717**
UNION TWP STP	Mifflin	0.650	0.400	**9,741**	4.9	**11,872**	**1,218**	0.62	**1,583**
LACKAWANNA RIVER BASIN SEW AUT (CLINTON)	Wayne	0.700	0.695	**16,925**	7.9	**12,785**	**2,116**	0.99	**1,705**
ASHLAND BORO	Schuylkill	1.300	0.765	**18,630**	4.7	**23,744**	**2,329**	0.59	**3,166**
SHICKSHINNY BORO SA	Luzerne	0.450	0.365	**9,741**	6.5	**8,219**	**1,111**	0.81	**1,096**
VALLEY JOINT SEW AUTH	Bradford	2.250	0.816	**19,872**	2.9	**41,095**	**2,484**	0.36	**5,479**
MCCONNELLSBURG STP	Fulton	0.600	0.400	**9,741**	5.3	**10,959**	**1,218**	0.67	**1,461**
CURWENSVILLE MUN AUTH	Clearfield	0.750	0.668	**16,268**	7.1	**13,698**	**2,033**	0.89	**1,826**
GALETON BORO AUTH	Potter	0.500	0.328	**9,741**	5.2	**9,132**	**998**	0.66	**1,218**
WEST EARL SEW AUTH	Lancaster	0.450	0.328	**9,741**	5.8	**8,219**	**998**	0.73	**1,096**
MAHANOY CITY SA	Schuylkill	1.380	0.780	**18,995**	4.5	**25,205**	**2,374**	0.57	**3,361**
DCNR-BALD EAGLE STATE PARK	Centre	0.450	0.321	**9,741**	5.7	**8,219**	**977**	0.71	**1,096**
NEW FREEDOM BORO AUTH	York	2.300	1.344	**32,730**	4.7	**42,009**	**4,091**	0.58	**5,601**
HASTINGS AREA SA	Cambria	0.600	0.350	**9,741**	4.7	**10,959**	**1,065**	0.58	**1,461**
MILLERSVILLE BORO	Lancaster	1.850	0.700	**17,047**	3.0	**33,790**	**2,131**	0.38	**4,505**
MANSFIELD BORO MUN AUTH	Tioga	1.000	0.703	**17,120**	5.6	**18,265**	**2,140**	0.70	**2,435**
GETTYSBURG MUN AUTH	Adams	2.450	1.880	**45,783**	6.1	**44,748**	**5,723**	0.77	**5,966**
MOUNT HOLLY SPRINGS BORO	Cumberland	0.600	0.437	**10,642**	5.8	**10,959**	**1,330**	0.73	**1,461**
ST THOMAS TWP MUN AUTH	Franklin	0.400	0.400	**9,741**	8.0	**7,306**	**1,218**	1.00	**974**
WHITE DEER TWP SEW AUTH	Union	0.600	0.447	**10,886**	6.0	**10,959**	**1,361**	0.75	**1,461**
PATTON BORO STP	Cambria	0.540	0.320	**9,741**	4.7	**9,863**	**974**	0.59	**1,315**
FRANKLIN COUNTY GENERAL AUTH (SOUTH PATROL RD)	Franklin	0.500	0.375	**9,741**	6.0	**9,132**	**1,142**	0.75	**1,218**
CUMBERLAND TWP MUN AUTH	Adams	0.650	0.400	**9,741**	4.9	**11,872**	**1,218**	0.62	**1,583**
MID-CAMERON AUTHORITY	Cameron	0.525	0.702	**17,096**	10.7	**9,589**	**2,137**	1.34	**1,279**
MILLERSBURG AREA AUTH	Dauphin	1.000	0.465	**11,324**	3.7	**18,265**	**1,416**	0.47	**2,435**
ABINGTON TWP SUPERVISORS	Lackawanna	0.500	0.336	**9,741**	5.4	**9,132**	**1,023**	0.67	**1,218**
ANTRIM TWP	Franklin	1.200	1.050	**25,570**	7.0	**21,918**	**3,196**	0.88	**2,922**
CAN-DO INC	Luzerne	1.000	0.280	**9,741**	2.2	**18,265**	**852**	0.28	**2,435**
UPPER ALLEN TWP BRD OF COMMRS	Cumberland	1.100	0.810	**19,726**	5.9	**20,091**	**2,466**	0.74	**2,679**
LITTLE WASHINGTON WW CO	Schuylkill	0.980	0.245	**9,741**	2.0	**17,899**	**746**	0.25	**2,387**
PORTER TOWER JOINT MUN AUTH	Schuylkill	0.430	0.600	**14,612**	11.2	**7,854**	**1,826**	1.40	**1,047**
LITTLESTOWN BORO AUTH	Adams	1.000	0.570	**13,881**	4.6	**18,265**	**1,735**	0.57	**2,435**
BURNHAM BOROUGH	Mifflin	0.640	0.480	**11,689**	6.0	**11,689**	**1,461**	0.75	**1,559**
BROWN TWP MA	Mifflin	0.600	0.400	**9,741**	5.3	**10,959**	**1,218**	0.67	**1,461**
WESTFIELD BORO	Tioga	0.460	0.400	**9,741**	7.0	**8,402**	**1,218**	0.87	**1,120**
SILVER SPRING TWP AUTH	Cumberland	1.200	0.400	**9,741**	2.7	**21,918**	**1,218**	0.33	**2,922**
ELKLAND BORO AUTH	Tioga	0.550	0.422	**10,277**	6.1	**10,046**	**1,285**	0.77	**1,339**
CUMBERLAND TWP AUTH (NORTH PLANT)	Adams	0.500	0.230	**9,741**	3.7	**9,132**	**700**	0.46	**1,218**

Facility Name	County	Annual Avge Design Flow	Projected 2010 Flow	Current Trib Strategy TN Cap Load at 2010 Flow @8 mg/l	Resulting TN Level at Design Flow Under Current Trib Strategy	Alternate TN Cap Loading at Design Flow @6 mg/l	Current Trib Strategy TP Cap Load at 2010 Flow @1 mg/l	Resulting TP Level at Design Flow Under Current Trib Strategy	Alternate TP Cap Loading at Design Flow @0.8 mg/l
MOUNT UNION	Huntingdon	0.950	0.546	**13,297**	4.6	**17,351**	**1,662**	0.57	**2,314**
LOGAN TWP BOARD OF SUPERVISORS	Blair	0.700	0.565	**13,759**	6.5	**12,785**	**1,720**	0.81	**1,705**
ROARING SPRING MUN AUTH	Blair	0.700	0.400	**9,741**	4.6	**12,785**	**1,218**	0.57	**1,705**
TRI-BORO MUN AUTH	Susquehanna	0.500	0.450	**10,959**	7.2	**9,132**	**1,370**	0.90	**1,218**
BLOSSBURG MUNICIPAL AUTHORITY	Tioga	0.400	0.328	**9,741**	6.6	**7,306**	**998**	0.82	**974**
WESTERN CLINTON COUNTY MA	Clinton	0.900	0.436	**10,618**	3.9	**16,438**	**1,327**	0.48	**2,192**
GREGG TWP MUN AUTH	Union	0.980	0.734	**17,875**	6.0	**17,899**	**2,234**	0.75	**2,387**
SOUTH MOUNTAIN RESTORATION CEN	Franklin	0.500	0.113	**9,741**	1.8	**9,132**	**344**	0.23	**1,218**
PA DEPT OF PUBLIC WELFARE	Lackawanna	0.600	0.100	**9,741**	1.3	**10,959**	**304**	0.17	**1,461**
MARTINSBURG MUN AUTH	Blair	0.700	0.439	**10,691**	5.0	**12,785**	**1,336**	0.63	**1,705**
LYKENS BORO AUTH	Dauphin	0.410	0.400	**9,741**	7.8	**7,488**	**1,218**	0.98	**998**
MARYSVILLE BORO COUNCIL	Perry	1.250	1.010	**24,596**	6.5	**22,831**	**3,075**	0.81	**3,044**
TOTALS			**384**	**9,401,000**		**9,721,000**	**1,170,000**		**1,296,000**
PHASE 1 85% TN Reduction (See Note)			**306**	**7,439,000**		**7,497,000**	**930,000**		**1,000,000**
PHASE 2 10% TN Reduction (See Note)			**43**	**1,053,000**		**1,181,000**	**132,000**		**157,000**
PHASE 3 5% TN Reduction (See Note)			**39**	**986,000**		**1,132,000**	**118,000**		**151,000**

Note: The phasing schedule is preliminary and may be subject to change.

This table was sorted based on the estimated loading that would occur in the year 2010 if no controls were implemented. This calculation used the 2010 flow multiplied by the estimated concentration obtained from sampling in 2002, or a default concentration of 22mg/l TN and 4 mg/l TP where no monitoring data were available.

Annual Average Design Flow	The average flow expected to come to the treatment facility on a daily basis in the design year of the facility.
Projected 2010 flow	Annual average daily flow expected at the treatment facility in the year 2010.
Trib Strategy 2010 TN Cap Load @ 8 mg/l	Load computed based on the 2010 projected flow and 8 mg/l of TN
Resulting TN Level at Design Flow Under Current Trib Strategy	TN Concentration that results from dividing the 2010 TN Cap load by the design flow of the facility
TN Cap Loading at 6 mg/l at Design Flow (Delivered)	Load computed based on using design flow at 6 mg/l.
Trib Strategy 2010 TP Cap Load @ 1 mg/l	Load computed based on the 2010 projected flow and 1 mg/l of TP
Resulting TP Level at Design Flow Under Current Trib Strategy	TP Concentration that results from dividing the 2010 TP Cap load by the design flow of the facility
TP Cap Loading at 0.8 mg/l at Design Flow (Delivered)	Load computed based on using design flow at 0.8 mg/l.

APPENDIX B

Survey Form

INSTRUCTIONS

Please complete the survey by entering responses in the highlighted cells. The cells have been formatted for the type of response (e.g. text, number, currency, date, percentage, etc.). If you have any need for clarification of the survey questions or assistance in completing the survey, please call Metcalf & Eddy's Chesapeake Bay Tributary Strategy Compliance Cost Survey HOTLINE at (908) 947-0258.

Please send electronic responses (preferred) to:
kyle.warren@m-e.aecom.com

Please send hard copy responses and attachments not available in electronic form to:
Metcalf & Eddy
Attn: CBTS Compliance Cost Survey
1700 Market Street, Suite 1700
Philadelphia, PA 19103

Responses can be sent via fax to (908) 707-8894 with "CBTS Compliance Cost Survey" in the subject line.

SECTION A - GENERAL INFORMATION

A1.	Discharger:	
A2.	Address:	
A3.	City:	
A4.	Zip:	
A5.	County:	
A6.	Contact Name:	
A7.	Title:	
A8.	Phone:	
A9.	Email:	

A10. May we contact your engineering consultant regarding this survey?

1. NO, we request that you do not contact our engineering consultant.
2. YES, you may contact our engineering consultant. Consultant contact information is provided in A11 - A14.

A11.	Consultant company name:	
A12.	Consultant contact name:	
A13.	Consultant phone:	
A14.	Consultant email:	

SECTION B - FACILITY INFORMATION

B1. NPDES permit number PA
B2. Expiration date: *enter as MM/DD/YYYY*
B3. Provide a brief description of the existing treatment process. To the extent applicable, discuss headworks, primary treatment, secondary treatment, clarification, filtration, and disinfection. The respondent may attach a previously prepared description (e.g. engineer's report, plant tour brochure) as a hard copy or electronic file and enter "See attachment" as a response below.

B4. Please provide a process flow diagram in hard copy or electronic file format.

1. YES, a process flow diagram has been provided
2. NO, a process flow diagram has not been provided.

Influent Flow Data

B5. Design annual average flow per current DEP WQM permit:
B6. Design annual average flow per DEP WQM permit on August 29, 2005:
B7. Average flow for period Sept. 1, 2004 - Aug. 31, 2005:
B8. Peak hourly flow as of August 2005:
B9. Average flow, estimated in 2010:
B10. Source of 2010 flow estimate:

Effluent Flow Data (mgd), if different than influent

B11. Average flow for period Sept. 1, 2004 - Aug. 31, 2005:
B12. Peak hourly flow as of August 2005:

Nutrient Cap Loads (lb/yr):

B13. Designated or anticipated N cap load:
B14. Designated or anticipated P cap load:
B15. Basis of N and P cap loads:

1. 6 mg/L TN and 0.8 mg/L TP at design flow on August 29, 2005
2. 8 mg/L TN and 1.0 mg/L TO at projected 2010 average flow

B16. Statement that best describes status of facility improvements for achieving N and P cap loads:

1. Improvements were not required. Facility already met designated cap loads prior to CBTS.
2. Improvements have been constructed or are currently under construction.
3. Construction contract has been awarded but construction has not started.
4. Final design is completed; construction has not yet begun.
5. Preliminary design is underway or has been completed.
6. Conceptual design is complete. A design concept has been selected, but design has not yet begun.
7. Initial facility planning and evaluation of options is underway, but not yet complete.
8. Initial facility planning has not yet begun.

B17. N and P reduction capability of existing facility and treatment process at 2010 flow:

1. High - Capable of meeting N and P cap loads
2. Med - Capable of moderate N or P reduction
3. Low - Capable of minor N or P reduction
4. None - Not capable of any N or P reduction

B18. N and P reduction capability of existing facility and treatment process at design flow:

1. High - Capable of meeting N and P cap loads
2. Med - Capable of moderate N or P reduction
3. Low - Capable of minor N or P reduction
4. None - Not capable of any N or P reduction

B19. Provide a brief description of improvements that have been or will be made for N and P reduction. If improvements are described in an engineer's report, the respondent may attach the relevant sections of the engineer's report as a hard copy or electronic file and enter "See attachment" as a response below. If response 7) or 8) in B16 was selected, enter "Unknown" as a response below and proceed to Section C.

B20. Construction start date (actual or anticipated): _____ *enter as MM/YYYY*

B21. Construction completion date (actual or anticipated): _____ *enter as MM/YYYY*

SECTION C - CONSIDERATION OF ALTERNATIVES

For Section C, please select the statement that best describes to what extent each option was considered or adopted (or planned for adoption) as a means of achieving N and P reduction. In each case, choose from the following responses:

1. Planned or implemented in lieu of facility improvements
   (i.e., cap loads to be met with no facility improvements)
2. Planned or implemented in addition to facility improvements
   (i.e., alternative was or will be used in conjunction with facility improvements to meet cap loads)
3. Considered but not implemented
   (i.e., alternative was considered but not selected as part of the overall approach to meeting cap loads)
4. Not considered
   (i.e., alternative was not considered; therefore it is unknown whether it would be a viable means of reducing N and P)

C1. Facility operational changes:

1. Planned or implemented in lieu of facility improvements
2. Planned or implemented in addition to facility improvements
3. Considered but not implemented
4. Not considered

C2. Purchase of nutrient reduction credits:

1. Planned or implemented in lieu of facility improvements
2. Planned or implemented in addition to facility improvements
3. Considered but not implemented
4. Not considered

If you selected statement 4 for Question C2, skip to Question C4; otherwise, go to Question C3.

C3. If nutrient credits are not considered a viable alternative, briefly discuss why. If nutrient credits are considered viable, indicate the quantity you have purchased or are planning to purchase.

C4. Elimination of on-lot septic systems:

1. Planned or implemented in lieu of facility improvements
2. Planned or implemented in addition to facility improvements
3. Considered but not implemented
4. Not considered

C5. Seasonal land application of treated wastewater:

1. Planned or implemented in lieu of facility improvements
2. Planned or implemented in addition to facility improvements
3. Considered but not implemented
4. Not considered

C6. Briefly describe any other alternatives considered. If previously described in an engineer's report, the respondent may provide the applicable sections as a hard copy or electronic file attachment and enter "See attached" as a response below. If no other alternatives were considered, enter "N/A" as a response below.

SECTION D - COST INFORMATION

Section D requests detailed information on estimated or actual costs for facility improvements to achieve nutrient removal. Some of the requested information may not be known at the requested level of detail at this time. Please report the requested cost information to the extent that it is currently available.

Capital Costs, Excluding Construction

Please report the capital costs that have been spent or are anticipated to be spent on the capital cost categories in D1 - D3. For costs that have already been spent, report the approximate date of contract for the expenditure. This information will be used to index incurred capital costs to present value. Otherwise, report anticipated costs for D1 - D3 in terms of present value.

D1a. Planning/Study: *(enter zero if included in design costs)*
D1b. Date of expenditure *enter as MM/YYYY. Leave blank if reporting present value*

D2a. Design:
D2b. Date of expenditure *enter as MM/YYYY. Leave blank if reporting present value*

D3a. Land acquisition: *(enter zero if not required or anticipated to be required)*
D3b. Date of expenditure *enter as MM/YYYY. Leave blank if reporting present value*

Construction Cost (General)

Questions D4 - D7 request construction cost information. For purposes of this survey, there is no need to index the source of reported construction costs to a present or future value. This survey accommodates the reporting of construction costs in past, present, or future values. However, it is critical that whatever means of reporting that is used, the costs be reported consistently in past, present, or future values.

D4. Please report the construction cost, along with a description and justification of improvements required to achieve N and P removal. This cost includes biological and/or chemical treatment processes improvements as well as "other related improvements" required for nutrient removal functionality.

Examples of "other related improvements" include:
-Solids processing improvements to handle additional sludge from N and P removal processes
-Instrumentation and control improvements associated with the N and P removal processes
-Civil site improvements required for expanded facility footprint due to N and P removal processes
-New or expanded buildings to accommodate new N and P removal equipment or increased staff
-Replacement of existing equipment (such as pumps or blowers) that has changed in capacity due to N and P removal requirement
-Headworks improvements required to properly operate the N and P removal equipment (e.g. installation of fine screens upstream of a membrane bioreactor)
-Other related improvements as determined by respondent

Examples of typically unrelated improvements include:
-Aging equipment that is being replaced in kind
-Headworks improvements that are not required by downstream N and P removal processes
-Any civil/site or building improvements not explicitly required by N and P removal processes
-Disinfection improvements

D4a. Construction cost of required/related improvements for N and P removal:

D4b. Itemization of improvements contributing to cost reported in D4a. For any improvements falling in the category of "other related improvements as determined by respondent", provide a rationale for why it was determined to be related.

D4c. Overall project construction cost, including non-related improvements:

D5. Please provide a copy of the construction cost estimate or schedule of values that was used as a source for D4 responses in hard copy or electronic file format:

1. YES, a copy has / will be provided.
2. NO, a copy has not been / will not be provided.

D6. Are the reported construction costs based on a construction contract (or bid to be awarded)?

1. NO. (Proceed to D7).
2. YES. (Answer D6a, skip D7, and proceed to D8).

D6a. Please indicate the date of the contract (or bid) used as basis of reporting construction costs:

enter as MM/YYYY

D7. The reported costs are based on a construction cost estimate. Indicate the source of the estimate.

D7a. Indicate the source of the estimate.

1. Cost estimate prepared by staff
2. Cost estimate prepared by consulting engineer

D7b. Report the accuracy of the cost estimate. For example, +30%/-20% (high end/low end) accuracy.

D7b-I. Accuracy of estimate - high end:

D7b-II. Accuracy of estimate - low end:

D7c. Are the reported construction costs based on a projected future value?

1. NO. (Proceed to D7d).
2. YES. (Answer D7c-I through D7c-III then proceed to D8).

D7c-I. Indicate the date corresponding to present day costs from which the future costs were projected:

enter as MM/YYYY

D7c-II. Indicate the assumed escalation percentage used to project future cost:

D7c-III. Indicate the assumed duration, in years, used to project future cost:

years

D7d. The reported construction costs are based on a past or present value. Indicate the date corresponding to the reported construction costs.

enter as MM/YYYY

Construction Cost (Detailed Breakdown)

D8. To the extent that information is available, please report construction costs per the breakdown in D8a - D8g. The sum of costs reported in D8a - D8g should equal the overall construction cost reported in D4c.

D8a. Mobilization, demobilization, bonds, and insurance:

D8b. Materials & equipment:
(Cost for material and equipment incorporated into the permanent facility improvements and turned over to owner at completion of construction. For example, materials would include structural concrete and steel, pumps, process equipment, electrical and control systems, etc.)

D8c. Labor:

D8d. Construction equipment:
(Costs for equipment and supplies used for construction. This equipment is not incorporated into the permanent facility improvements and generally includes rented construction equipment.)

D8e. Special construction:
(Cost of for special construction activities. For example, dewatering, rock excavation, bypassing, pile foundations, sheeting, disposal of contaminated soil, etc.)

D8f. Contingency: [ ]
(In the case of cost estimates, report amount of contingency. In the case of construction contracts or bids, this value will be zero, unless there is an owner-stipulated allowance to cover minor changes in the work.)

D8g. Engineering, legal, and administrative fees for construction phase: [ ]

D8h. Overall construction cost (sum of D8a - D8g): [ ]

D8i. Does the reported cost in D8h equal that reported in D4c?

1. YES (proceed to Question D9).
2. NO (recalculate construction cost breakdown or provide explanation below).

Explanation of difference between D8h and D4c:

[ ]

Construction Financing Costs

D9. Was construction financed externally (by loan or bond) or is it anticipated that it will be financed externally?

☐ YES — Answer questions D10 - D13
For completed construction, report actual costs and rates.
For future construction, report anticipated costs and rates.

☐ NO — The project was or will be financed by on-hand cash reserves.
Skip questions D10 - D13. Proceed to question D14.

D10. Amount financed: [ ]
D11. Financing costs: [ ] *(e.g. closing costs)*
D12. Interest rate: [ ]
D13. Amortization period: [ ] years
D14. Annualized financed costs: [ ]

Operations and Maintenance Cost Impacts

D15. Annual operations and maintenance costs prior to facility improvements and reference year:
$ [ ] year [ ] *enter as YYYY*

D16. Annual operations and maintenance costs (projected or actual) after facility improvements and reference year:
$ [ ] year [ ] *enter as YYYY*

D17. Percent increase or decrease in operations and maintenance costs:
[ ]

Residential User Rate Schedule Impacts

Please indicate the billing cycle, basis for billing, and billing rate for domestic users prior to facility improvements for N and P removal. If you have multiple rate districts, use the rate of the district with the largest number of customers.

D18. Billing cycle:

☐ a) Monthly

☐ b) Quarterly

☐ c) Other (describe):

D19. Basis of Billing and User Rates:

☐ a) Flat rate $

☐ b) Fixed service charge added to meter usage $

☐ c) Metered $ (total cost based on 10,000 gal/month)

D20. Indicate the actual or projected percent rate increase associated with facility improvements represented by the cost shown in D4c.

D21. If more than 10% of rate schedule revenues are from industrial/commercial users, please describe the current rate schedule and indicate the actual or projected percent rate increase associated with facility improvements represented by the cost shown in D4c. If less then 10% of rate schedule revenues are from industrial/commercial users, enter "N/A" as a response below.

THIS CONCLUDES THE SURVEY. THANK YOU FOR YOUR PARTICIPATION.

Please send electronic responses (preferred) to:
kyle.warren@m-e.aecom.com

Please send hard copy responses and attachments not available in electronic form to:
Metcalf & Eddy
Attn: CBTS Compliance Cost Survey
1700 Market Street, Suite 1700
Philadelphia, PA 19103

Responses can be sent via fax to (908) 707-8894 with "CBTS Compliance Cost Survey" in the subject line.

APPENDIX C

Survey Database and Original Responses

Available Upon Request

APPENDIX D

Site Visit Memoranda

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 21, 2008
Plant:	Abington Township (Waverly, PA)
Attendees:	Tom James, Maintenance Superintendent William White, Township Manager Ned Slocum, Milnes Engineering, Inc.
Prepared by:	Andrew Arsenault
Project. No.:	60044954/425

Existing Treatment Plant

Two pumps station in the collection systems pumps wastewater to comminutors at the plant site. There is currently flow monitoring where the water enters the plant. After the WW goes through the comminutors it then flows into the first aerated facultative lagoon. From there the WW flows into a second aerated facultative lagoon. The plant currently has a 30 day detention period for both lagoons. From the second lagoon, the WW flows to the chlorine contact tanks (CCTs) for disinfection, and then into the creek by gravity. They are currently chlorinating by using chlorine gas.

There are currently no sludge removal facilities on site. The second lagoon was drained about 2 years ago after being in service for 7 years. The lagoon was dredged and the sludge brought to a landfill. The lagoons are 10 feet deep. The first aerated lagoon has never been drained. Tom James believes they will have to drain, and dispose of the sludge next year.

The plant flow rate varies from 0.120 MGD to about 0.60 MGD. There are a lot of I/I problems currently at Abington Township.

On a daily basis, there is little or no maintenance needed at the plant. However, Tom James does take daily samples at the effluent outfall.

Design annual average flow per current DEP WQM permit – 0.50 MGD

Estimated average flow in 2010 is 0.36 MGD

Effluent nutrient conc. – Monthly avg. for 2007 & 2008 -Total N (mg/l) – 12.93

Effluent nutrient conc. – Monthly avg. for 2007 & 2008 -Total P (mg/l) – 1.13

Proposed Upgrades

Ned Slocum, of Milnes Engineering, filled out the survey for Abington Township. Ned is the township engineer.

In the survey Ned stated that approximately $5,000,000 will be required/related to improvements for N and P removal. Ned has not completed a feasibility study for this plant. This number was estimated based on Ned's background and experience. Ned and his company did not look into any design options for a new plant because of the $5,000,000 price tag.

Ned stated that they can't really retrofit the existing plant without placing something at the end of the facility. However, land is tight and they need additional space in order to do so. Ned also mentioned that they could abandon the existing treatment plant and build a new one. However, that isn't an option because of the price in doing so. Ned stated that the costs to retrofit vs. the cost to build a new plant are pretty much the same.

Because of the high design/construction cost, Ned stated that they will purchase credits in order to meet DEP regulations.

<u>Nutrient Trading Program</u>

Since the existing plant is under Phase I, they will begin purchasing credits in 2010. Ned stated that it is estimated that 3700 pounds per year of TN credits will be required to be purchased based on the current average daily flow. Tom James stated the cost of purchasing credits will be significantly lower than designing/constructing/operating a new treatment plant.

Abington Township is looking to purchase credits from the Red Barn Trading Company. They have already reached out to the company and know that they have 100,000 lbs/year available. About 3700 lbs would equate to $33,000/yr for Abington Township to purchase. Abington would like to enter into a 5 year agreement with Red Barn Trading Company, but they haven't discussed that with them yet.

<u>Schedule</u>

Abington Township is in Phase I and must comply by 2010. They will begin purchasing credits in 2010.

<u>Cost and Financing</u>

Tom, William, and Ned both stated that there are no grants available for designing a new treatment plant. William stating that purchasing credits is pretty much a fine that they'll pay every year since they don't have any money to construct a new plant. Tom stated that the O&M costs on a new treatment plant would cost more than the $33,000 he'd have to pay for purchasing credits.

Tom also stated that purchasing credits from Red Barn is only a temporary fix. The Red Barn Trading Company is thinking about moving out West. If they do so, Tom isn't sure who they will buy credits from. If this happens after 2010, he isn't sure what they'll do. He stated that Abington Township is a very old community with approximately 700 dischargers. The community couldn't afford additional rate increases that would be related with the construction of a new treatment plant.

The current billing cycle is done yearly. They currently charge the residents $400/year. In 1993 the rate went from $300/year to $400/year. William stated that another $100 increase would most likely happen in 2010, because of the credits that need to be purchased.

If a new treatment plant has to be built William is thinking about increasing the rates by 300% in order to pay for the design/construction/maintenance of the new facility. He speculated that if this happens, numerous people would move out of the community.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 21, 2008
Plant:	Annville Township WWTP
Attendees:	Charles Moll, Superintendent Dale Shoppe, Engineer, Gannett and Fleming
Prepared by:	Nalan Tepe-Sencayir
Project. No.:	60044954/425

Existing Treatment Plant

The wastewater from the Township is collected and conveyed to influent pump station at the treatment plant. They also accept outside hauled sewer and some industrial wastewater. Hauled wastewater is collected in the unused backwash storage tank and introduced to system by intervals. Both sewered and hauled wastewater is pumped by three dry well pumps to the first stage of aeration. They will get a grinder for the pump station before the upgrades.

First stage provides carbonaceous treatment by two circular contact stabilization tanks. Each tank has a contact aeration, re-aeration, aerobic digester and clarifier in the center. Thickened sludge from clarifiers is aerobically digested. Supernatant goes to secondary stage split box where ferrous sulfate is added for phosphorus precipitation.

The secondary stage has conventional aeration tanks (2) and circular final clarifiers (2). Only one of each was in use at the time of site visit. For all the aeration processes course bubble aeration is provided by 3 constant speed centrifugal blowers.

For final polish, there are 3 down-flow in-vessel sand filters, however, they are not in use and are operated routinely just to keep them functional. Finally, the effluent is chlorinated. Class B aerobically digested sludge is land applied at local farms, in winter, they are pumped to reed beds which function as storage more than treatment.

Proposed Upgrades

With the upgrades they will retain same flow but increase the organic load capacity. A septage receiving facility and headworks will be built as part of the upgrades, but this is not BNR related. They would build these anyway; currently they do not have any equalization for hauled septage accept the temporary storage in the backwash water tanks. Also they would like separate the solids to avoid maintenance problems. Pumps in the effluent pump station will be replaced with VFDs.

They will keep the same configuration for first and second stage. They are working fine on BOD removal except air cannot be controlled. The DO is currently monitored at the second stage but not affecting the operational changes. The blowers will be replaced with positive displacement VFD controlled blowers and each tank will have a designated blower. Also all diffusers will be converted to fine bubble to increase efficiency. The engineer is also looking into converting aerobic digesters to ATAD.

Secondary stage will stay the same, only they will increase the ferric addition to achieve lower P.

Sand filters will be replaced with denite filters. At the time of the site visit, a denite filter system by ITT was being pilot tested. Methanol will be used as C-source. The aeration will be operated at a set DO, if they have excessive DO, more methanol will be consumed at the filters. This is why they counted DO control and blowers through BNR cost. They will name the Tetra as second manufacturer. This is more for nitrogen removal but also they will capture more precipitated P, therefore, it will reduce their P levels too.

The existing and proposed processes are modeled by GPS-X. They looked at MLE and Bardenpho. These would require changes to existing aeration tanks also would not be feasible for accepting hauled sludge.

They will continue to produce and land apply Class B biosolids.

Existing influent levels TKN= 49 ppm NH_3=31 ppm TP=5-7 ppm

Existing effluent levels P= 1-2 as PO_4 and 0.1 mg/L as NH_3

Design effluent levels will be TN=3 ppm TP= 0.8 ppm

Cost of BNR

The engineer provided cost breakdown. The pump station upgrade and sewage receiving facility were not counted for the BNR in the cost breakdown. The difference between the BNR related cost and total construction cost is coming from these items. The major portion of the BNR related cost is denite filters. They are not changing biological treatment other than the DO control.

Per the O&M cost, their chemical cost will increase since they will be adding more ferric solution and of course methanol addition at the tertiary stage. However they are expecting decrease in energy consumption at the blowers since the efficiency of the aeration will be increased by using fine bubble and air supply control by VFDs.

Nutrient Trading Program

Before the upgrade design, they shortly thought about the trading program, but details are still up in the air, they do not think it is cost effective. They think the trading program is at infancy stage with too many variables and not quite stable yet. But they will treat nitrogen more than required and the Authority would definitely consider selling the credits.

Schedule

The engineer is waiting for approval for final design. If they are approved by October 2008, they will be bidding by next summer with an anticipated completion construction in 2010 summer. They are required to comply by 2012 but they would like to complete construction by 2010. Engineer recommended bidding the project ASAP. Because once Phase I plants start to bid the prices will be up and it will be difficult to find bidders.

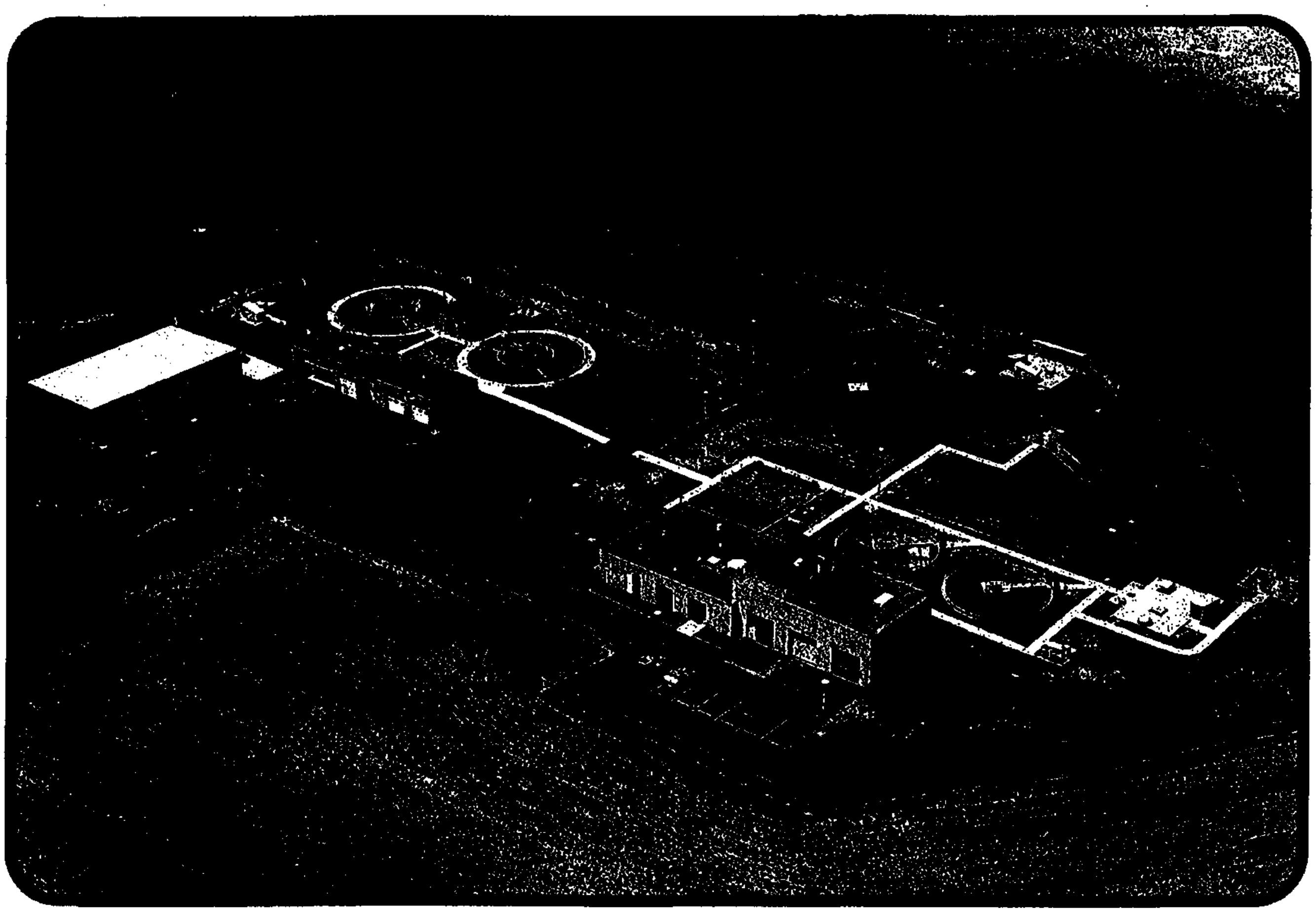
<u>Financing</u>

They will finance by conventional bonds. They cannot apply Pennvest because they do not have Act 537 Plan.

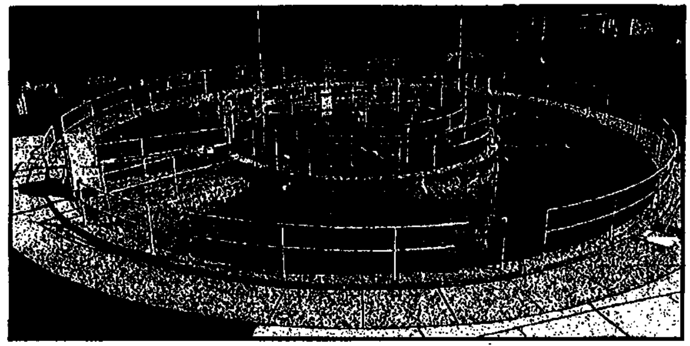
The current rates are structured based on $58 per quarter up to 12,800 gal and about $4.28 for each additional 1,000 gal. The last increase was last year that increased the rate from $55 to $58. This was just a routine rate increase. The rates will be almost doubled after the increases related upgrade. They will introduce the rate change by several stages. Hauler fees will be also changed.

Water Pollution Control Facility

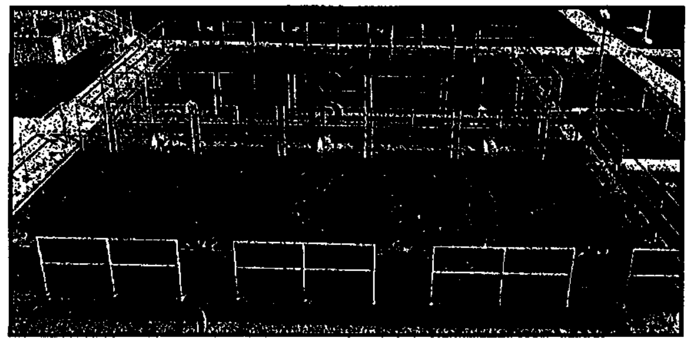
Annville Township Authority
ANNVILLE, PENNSYLVANIA



PLANT PUMPING STATION
Wastewater flows by gravity to the pumping station where it is lifted to the contact stabilization units.

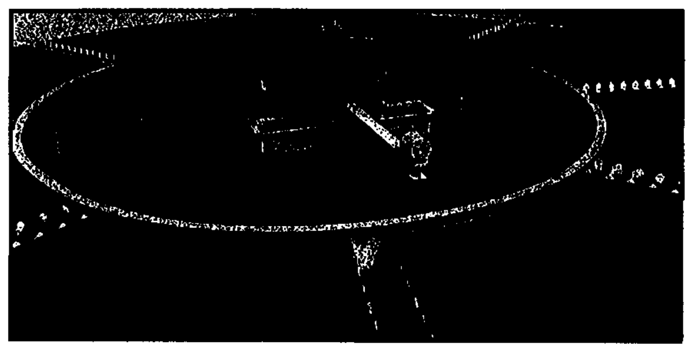


CONTACT STABILIZATION UNITS
(a) The contact aeration and reaeration tanks mix the wastewater and provide oxygen for the microscopic organisms feeding on the organic portion of the wastewater.
(b) The biological sludge settles to the bottom of the first-stage clarifiers and the clear water flows over the top of the tank to the next treatment stage.
(c) The aerobic digesters mix and aerate the thickened sludge from the clarifiers. This process renders the sludge biologically stable.



SLUDGE THICKENERS
Sludge drawn from the clarifiers is thickened by slow mixing and gravity settling and then transferred to the aerobic digesters.

SECOND-STAGE AERATION TANKS
First-stage effluent is mixed and aerated in the absence of organic wastes. In this environment microscopic organisms stabilize ammonia.



FERROUS MIX TANK
Liquid ferrous is added for the removal of phosphorus compounds.

SECOND-STAGE CLARIFIERS
The biological sludge and phosphorus precipitate settles to the bottom and the clear water flows to the multi-media filters.

MULTI-MEDIA FILTERS
Particles of sludge too fine to settle in the clarifiers are removed by the filters.

CHLORINE CONTACT TANKS
The plant effluent is disinfected by addition of a chlorine solution.

EFFLUENT STRUCTURE
A concrete structure was placed at the bottom of the Quittapahilla to protect the effluent pipe and to smoothly blend the plant effluent with the creek flow.

REED BED
Stabilized sludge from the aerobic digesters can be reduced to a dry solid on the reed-bed. Ultimately, the sludge is applied to farm land as a valuable soil conditioner and plant fertilizer.

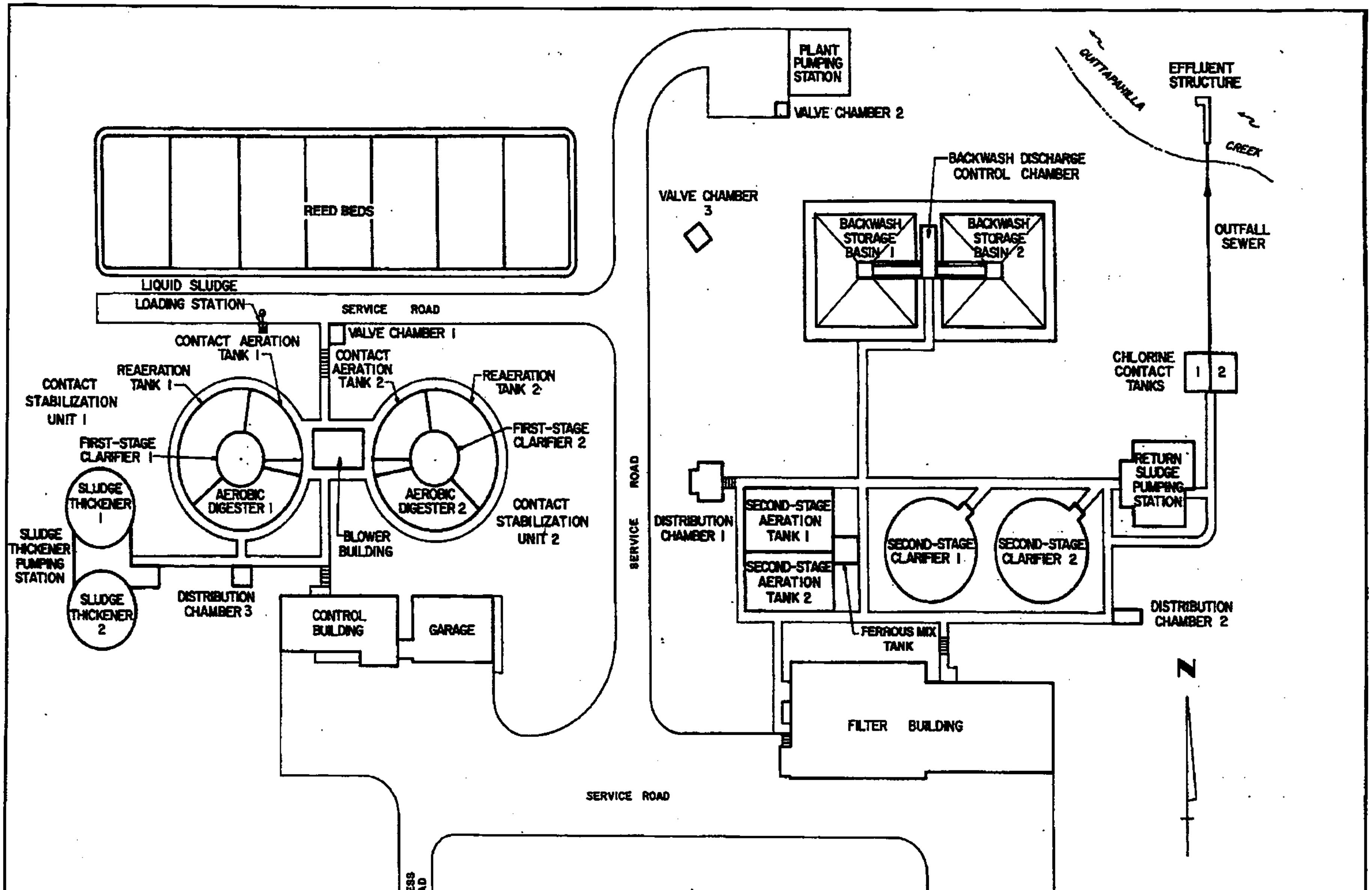


PLATE I-3
WASTEWATER TREATMENT PLANT LAYOUT

DESCRIPTION OF THE WASTEWATER FACILITIES

The wastewater collection system and treatment plant were constructed in 1967 by the Annville Township Authority at a cost of $2,815,000. The collection system was extended in 1969 to its present size, approximately 18.9 miles. Except for a few residences in scattered locations, all developed areas of the Township are served by the collection system.

The wastewater treatment plant, constructed in 1967, provided secondary treatment by the contact stabilization activated sludge process. The plant was designed to remove approximately 85% of the biochemical oxygen demand (BOD) and suspended solids from 600,000 gallons of wastewater daily. This facility included the plant pumping station, two contact stabilization tanks with aerobic digesters and chlorination compartments, outfall sewer, blower building, control building, and drying beds.

An order issued on April 12, 1971, by the Pennsylvania Department of Environmental Resources required the Authority to upgrade the degree of treatment. Therefore, construction was begun on the new facilities in 1978. The design incorporates all the existing structures and equipment with the new second-stage aeration tanks, second stage clarifiers, return sludge pumping station, chlorine contact tanks, effluent structure, filter building, backwash storage basins, and chemical addition equipment. The upgraded facility is capable of removing nearly all of the BOD and suspended solids and reducing the concentration of phosphorus and the ammonia nitrogen concentrations to 2 mg/1. The design flow was increased to 750,000 gallons. The upgrading and expansion project for the treatment plant was constructed at a cost of $3,100,000.

PROJECT FUNDING:

Funding Source 1978

EPA Grants	$1,960,000
Available Authority Funds	$ 740,000
Farmers Home Administration Loan	$ 400,000

Funding Source 1967

EPA Grants	$ 400,000
Available Authority Funds	$ 115,000
Bond Issue	$2,300,000

ANNVILLE TOWNSHIP:

Board of Commissioners:

Kyle L. Smith - President
Richard F. Charles - Vice President
Conrad L. Liles
Joann F. Zimmerman
Hugh P. Rooney Jr.
Keith G. Kramer - Township Secretary
Charles H. Moll - Plant Superintendent

LEGAL COUNSEL:

Timothy D. Sheffy, Esq.

ANNVILLE TOWNSHIP:

Authority:

Jesse V. Shaak - Chairman
Karl K. Brown - Vice Chairman
Raymond J. Swingholm - Treasurer
David M. Horn - Secretary
Owen A. Moe - Asst. Secretary Treasurer

CONSULTING ENGINEER:

Gannett Fleming, Inc.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 26, 2008
Plant:	Bloomsburg Municipal Authority
Attendees:	Mark Tappe – Assistant Superintendent
Prepared by:	Andrew Arsenault
Project. No.:	60044954/425

Existing Treatment Plant

The Bloomsburg WWTP currently consists of 3 sewage pumps, followed by 2 comminutors and screening. The flow then travels to a splitter box where it then flows to primary settling, mechanical aeration tanks, secondary settling, and then disinfection with chlorine gas. The plant also has 3 sludge holding tanks, 2 sludge pumps, and 2 - 25 year old belt filter presses. An existing chlorine building houses the chlorine feed pumps, plant drain pumps, and RAS/WAS pumps.

Design annual average flow per current DEP WQM permit – 4.29 MGD

Estimated average flow in 2010 is 2.85 MGD

Effluent TN values – Did not know

Effluent TP values – Did not know

Proposed Upgrades

The first existing aeration tank will be converted to an anoxic zone while the second existing aeration tank will be converted to an aeration zone with fine bubble aerators. A new flocculation tank will be constructed, after the aeration tank, for the enhancement of phosphorus removal. The primary and secondary clarifiers will remain as is. The gas chlorination system will be replaced with a liquid chlorination system, and a new blower building will also be constructed to house two new blowers.

All three existing sludge pumps will be replaced with submersible type pumps. Both existing filter presses will be replaced with two new Fournier presses. Both existing comminuters will be replaced with two new "Muffin Monsters." And the two existing sludge pumps will be replaced with a four air operated submersible pumps, and an additional one as a spare. RAS/WAS and plant water pumps will be replaced and housed in new building on the site. An entire new electrical system will be placed in a new room above the flood plain.

Aeration tank walls and secondary clarifier tank walls will be increased to prevent overflowing during storm events. Significant flooding had taken place in 1996, 2004, and 2005. The walls of the primary clarifiers have already been increased to prevent flooding.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 29, 2008
Plant:	Chambersburg
Attendees:	Mark Perry
Prepared by:	Brian Aylaian
Project. No.:	60044954/425

The existing plant design flow is 6.8 MGD and annual average flow is 6 MGD. The existing plant liquid treatment process consists of headworks, PCs, VLR, SCs and UV disinfection. The upgrade (including expansion to build-out flow of 10.8 MGD) includes modifications/expansion of headworks, PCs, VLR process (mods to existing and new duplicate tank), SCs, and UV system. The engineer is still is the planning and conceptual design stage, thus the final scope of work is not yet finalized. If expansion is selected, total cost is $42M.

Of the $42M, $10M is allocated to nutrient removal consisting of:

- Existing VLR tank process upgrade
- New VLR tank (same design as process upgrade to existing)
- Methanol feed system
- Metal salt chemical feed system
- Electrical and I&C-related improvements

Of the $32M not allocated to nutrient removal, the scope of work is:

- $15M for solids handling
- $17M for headworks, pump station, clarifiers, splitter box, and UV improvements

Mark attests that none of the remaining $32M can be attributed to BNR. The sludge process is a conversion to an ATAD process and accommodations for expansion. The increase in sludge due to nutrient removal is a not a significant cost addition.

It seems that part of the new tank construction cost would be attributable to the expansion, but how to break that out would be a challenge. The expanded flow must also be treated to nutrient removal limits, so a lot of the construction of the new process is due to nutrient removal. Recommendation is to use the engineer's estimate even though it may be conservative, especially since there are probably other parts of the $32M that could be attributable to nutrient removal that were not included (minor increase in sludge handling noted above, mods to clarifiers for P-feed, etc.)

With regard to the trading program, the engineer and Borough feel that the program is not reliable and there are no opportunities to trade with plants on their watershed at the present. Negotiations with the farmers in the Franklin County Conservation District have been only talk with nothing solid to rely on. The overall opinion of the program is poor.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 26, 2008
Plant:	State Correctional Institute at Dallas, PA
Attendees:	Mark Kinder, Chief Operator Mark Voyack, of Quad3 Engineers
Prepared by:	Andrew Arsenault
Project. No.:	60044954/425

Existing Treatment Plant

Thomas Campenni filled out the survey. His title at the treatment plant was Corrections Facility Maintenance Manager III. I was told that Thomas was out on indefinite leave and no one knew when he was going to be back working at the treatment plant. Instead, I was able to meet with Mark Kinder, who is the current chief operator of the plant.

The existing treatment plant consists of a barscreen and comminutor for headworks, followed by an equalization tank. After the EQ tank, flow enters two primary clarifiers, two trickling filters, and three secondary clarifiers. After flow leaves the secondary clarifiers, it goes to the chlorine contact tanks and then gravity flow to the river.

There is an existing blower building and sludge holding tank. The sludge holding tank takes sludge from the primary and secondary clarifiers. Sludge is taken off site and processed at the Wyoming WWTP.

Design annual average flow per current DEP WQM permit – .45 MGD

Estimated average flow in 2010 – Not Given

Effluent TN values – 10.13 mg/l

Effluent TP values – 1.9 mg/l

Proposed Upgrades

Thomas Campenni, the Maintenance Manager III, filled out the survey. As stated previously, he did not attend the meeting.

The proposed upgrade is to abandon the existing primary clarifiers, trickling filters, and secondary clarifiers and provide a new Sequential Batch Reactor (SBR) type secondary treatment process. This process will consist of the following:

- Two 30" wide x 85' long concrete process tanks
- Two fine bubble aeration systems
- Two stainless steel decant mechanisms

- Three process blowers
- Two waste sludge pumps
- Two submersible mixers
- One PLC-based process control system

In addition to the SBR process, two polishing drum filters will be installed to assure current and future nitrogen limits are achieved and a liquid aluminum chemical feed pump and tank will be installed for phosphorus removal. Improvements to the effluent wastewater disinfections will involve the construction of a new ultraviolet light disinfection channel adjacent to the existing chlorine contact tanks. A new building will be constructed to house the blowers, polishing drum filters, and the liquid aluminum chemical feed system.

The existing chlorine contact tanks will remain in place and operational as a back up unit and for use during UV cleaning. The plant is also planning on leaving the secondary clarifiers in place, and piped up, in case of an emergency. The EQ basin and sludge holding tank will remain as is.

Mark Voyack, of Quad3 Enginners, settled on the SBR system because they were very familiar with it having already designed this system numerous times. He knows that the SBR system produces high quality effluent. He told me that he didn't look into any other alternatives.

The following alternates will improve the plant operation, however are not crucial to meeting the effluent concentrations:

- Alternate 1: Construction of a new headworks structure to accommodate a parshall flume and a fine screen/compactor device.
- Construction of a dividing wall in the existing equalization tank, to provide for maintenance and cleaning while still affording a means of flow equalization.
- Demolition of existing trickling filter tank.

<u>Nutrient Trading Program</u>

Nutrient trading program was not considered.

<u>Schedule</u>

The project is planned to be bid out in January 2009 and be constructed by the end of the year.

<u>Cost and Financing</u>

The project is being financed through the State Department of Corrections and the Department of General Services.

The overall cost for the project given in the survey was $2,352,500. After meeting with Mark Voyack, and looking over the cost estimate, Mark agreed to take out the costs for the chlorine feed equipment, and a percentage of the new electrical controls for a total of $60,500. The new project cost for the BNR upgrade is approximately $2,292,000.

**CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY
FOR
LEGISLATIVE BUDGET & FINANCE COMMITTEE
OF THE PENNSYLVANIA GENERAL ASSEMBLY**

SITE VISIT MEMORANDUM

Date of visit:	August 21, 2008
Plant:	Dillsburg Area Authority
Attendees:	Tom Whittle
Prepared by:	Brian Aylaian
Project. No.:	60044954/425

Actual total plant upgrade is $11M, nutrient removal related costs $10M. The $1M that is not nutrient related is the cost of relocation of the UV system and some sludge treatment improvements. Upgrade will be adding additional train and adding MBR at the end of each train. Reason for this is very tight site constraints. Also, this plant discharges to a very small stream and DEP has hinted that there will be very restrictive TMDLs applied to this plant.

Current plant is activated sludge only with limited capability for BNR. They are even using one of the clarifiers as active aeration volume tankage. Conversion to Bardenpho limits tanks volume such that plant basin expansion is required. There is no expansion built in to the project, although the MBRs could be considered to be a design addition that allows room for growth in the future. A tertiary filter (less expensive than MBR) could have been selected in lieu of MBR technology, however, the MBRs use less space and provide higher level of treatment capacity. There is the possibility that they could use their advanced treatment for trading with other plants that will not be able to make their nutrient cap loads. The other advantage of the MBRs is that the technology allows them to run with higher MLSS (12,000 mg/l) and reduced the size of the tank upgrade that is required. Conversely, it gives them extra safety margin in the level of treatment.

With regard to the trading program, because of the tight TMDLs, Dillsburg will not be able to take advantage of the trading program. Also, there is apparently a large up front cost that participants must pay in order to get into the program, and this further discourages participation. CET (the Authority's consultant) has only one wastewater authority client that plans to actively participate in the program.

Nutrient removal will be achieved mostly in the SBRs and constructed wetlands will be used as polishing stage. For the reason of selection, the engineer told me wetlands are 'passive' and 'green', also requires less sludge management.

The future plant will be discharging to Elizabeth Run. Even though they did not request any draft limits from DEP yet, they are expecting to have 2 ppm TN and 1 ppm TP assuming higher TMDL and annual cap. Just after their discharge point, the run merges with a bigger branch and they think it will give them a relief on the limits.

Influent TN= 20-25 ppm and TP= 12-15 ppm

Cost of BNR

The overall budget was reported as $3.5 million, $600K being BNR. It was a rough estimate. Since they are building a brand new plant for much higher flows, relatively low BNR cost is reasonable. During the meeting, the engineer mentioned BNR portion might be around $600K up to $1 million.

Nutrient Trading Program

Nutrient trading program was not really considered as a viable option. Giving the unknowns, it is difficult to estimate future cost of nutrient trading. If they have a contract with a farmer, they need to control the farm in some way and no farmer would let you do that. In addition, it would be very difficult to find a farmer that will sign a contract for 30 years. Even if there is such farm, what would happen if the farmer dies, or bankrupt.

However, when a plant is built, the authority has full control of it and they know what they can achieve. The board members have no expertise on farm practice and admin, also the budget is very limited to hire an agricultural expert to control the practices at the farms.

Also, there is the thrust issue. Even if everything works out and they successfully follow the trading program, nobody can assure them it will not be changed after 20 years. Legislators change their minds or somebody else takes their place, then they come up with new rules.

Schedule

Design will be completed by the end of 2008. An Act 537 plan will be submitted this fall. Upon approval they will submit Part II permit. They do not know when they can start construction. Some of the supervisors would not like to approve the plant relocation. So there is some political resistance that needs to be resolved.

Financing

They received a growing greener grant from DEP in the amount of $100,000. They will also apply for Pennvest. They are expecting significant rate change. The most recent significant rate change took place in 1994 when they had a number of sewer expansion.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 20, 2008
Plant:	Freedom Township Water & Sewer Authority
Attendees:	Darby Neidig – Metcalf & Eddy Mike McClain – Stiffler, McGraw and Associates, Inc. Steve Wagner – Stiffler, McGraw and Associates, Inc. Kellen Douglass – Stiffler, McGraw and Associates, Inc. Joe Stuby – Freedom Township WSA Rick Hoover – Freedom Township WSA
Prepared by:	Darby Neidig
Project. No.:	60044954/425

Cost Estimate – Construction costs were reported as $3.0M for nutrient removal and $5.7M for the overall upgrade project. Discussions revealed that additional plant upgrades may contribute to BNR related costs. Refer to attached cost breakdown and comments.

BNR Driven Upgrades – Existing equipment and tanks are in very good condition. Fine screens will be constructed in a new headworks facility. Two existing contact stabilization tanks will be converted to settling tanks to accommodate additional solids produced by BNR. A third settling tank will also be constructed. Two remaining units will be converted to Bardenpho treatment units. Two new digesters will be constructed to replace the capacity lost as a result of the contact stabilization tank conversion. A conceptual design has been established. Construction would likely begin in June 2010.

A rotary fan press will be installed to accommodate the additional solids production that will result from nutrient removal processes, which will enable landfill disposal of the dewatered sludge. Current disposal is accomplished by land application of liquid sludge withdrawn directly from the digesters at 2% solids. The higher sludge production will make land application impractical due to increased number of loads to be hauled and application limitations created by weather and seasonal conditions. Landfill disposal will be less labor intensive than land application and disposal may be accomplished during any weather condition or at any time of the year. The Authority also has concerns regarding future land application regulations. FTWSA believes they may be entitled to additional BNR credits as a result of landfill disposal as opposed to land application of a liquid sludge.

Alternatives - Several other alternatives for BNR were considered. All of the options were either too costly, did not provide sufficient BNR or provided a much higher level of

O&M. Such considerations include SBR, conveyance to Holidaysburg Regional WWTP, sand filters and membrane filtration.

Nutrient Credits - FTWSA is not currently interested in the program. Concerns exist over availability and long term cost of credits. The Authority will upgrade the WWTP to meet BNR. Additional removal may entitle the Authority to sell BNR credits. Detailed description provided under response to question C3 of the Survey.

CTSB COMPLIANCE COST ALLOCATION
FREEDOM TOWNSHIP WATER & SEWER AUTHORITY
EAST FREEDOM, PA

TREATMENT TRAIN / COMPONENT	TOTAL COST	UPDATED ESTIMATE		ORIGINAL ESTIMATE		COMMENTS
		% to CTSB	CTSB COST	% to CTSB	CTSB COST	
Raw Sewage Pumps	$ 75,000	5%	$ 3,750	0%	$ -	Small portion of pump capacity increase attributed to additional recycled flow for nutrient removal.
Headworks					$ -	Additional fine screens for higher level screening required for nutrient removal.
Headworks Building	$ 175,000	40%	$ 70,000	0%	$ -	
6 mm Screen	$ 200,000	25%	$ 50,000	0%	$ -	
Access Road	$ 30,000	0%	$ -	0%	$ -	
Unit 4 Bardenpho Conversion	$ 365,000	100%	$ 365,000	100%	$ 365,000	Conversion of existing unit to meet nutrient removal requirements.
Unit 3 Bardenpho Conversion	$ 345,000	100%	$ 345,000	100%	$ 345,000	Conversion of existing unit to meet nutrient removal requirements.
Chemical Feed Systems	$ 200,000	100%	$ 200,000	100%	$ 200,000	New chemical feed system required for nutrient removal.
Unit 1 Settling Tank Conversion	$ 500,000	100%	$ 500,000	100%	$ 500,000	Conversion of existing unit to meet nutrient removal requirements.
Unit 2 Settling Tank Conversion	$ 500,000	100%	$ 500,000	100%	$ 500,000	Conversion of existing unit to meet nutrient removal requirements.
New Settling Tank			$ -		$ -	Additional settling capacity required to accommodate increased solids production as a result of nutrient removal.
Excavation	$ 40,000	10%	$ 4,000	0%	$ -	
Concrete	$ 300,000	10%	$ 30,000	0%	$ -	
Walkway	$ 75,000	10%	$ 7,500	0%	$ -	
Drive	$ 75,000	10%	$ 7,500	0%	$ -	
RAS Pump	$ 30,000	10%	$ 3,000	0%	$ -	
WAS Pump	$ 25,000	10%	$ 2,500	0%	$ -	
UV Disinfection	$ 280,000	0%	$ -	0%	$ -	UV upgrade driven by increased capacity. Nutrient removal contribution is N/A to UV requirements.
Digesters			$ -		$ -	New tankage to accommodate digester requirements lost as a result of Unit 1-4 settling tank conversions.
Excavation	$ 50,000	50%	$ 25,000	50%	$ 25,000	
Concrete	$ 400,000	50%	$ 200,000	50%	$ 200,000	
Diffusers / Air Piping	$ 75,000	50%	$ 37,500	50%	$ 37,500	
Dewatering Building	$ 100,000	50%	$ 50,000	50%	$ 50,000	
Slow Speed Rotary Press	$ 300,000	50%	$ 150,000	50%	$ 150,000	New press to accommodate increased solids due to nutrient removal.
Blower Building	$ 125,000	10%	$ 12,500	0%	$ -	Small portion of increased air demands attributed to increased capacity due to nutrient removal.
Additional Blowers (2)	$ 80,000	10%	$ 8,000	0%	$ -	Small portion of increased air demands attributed to increased capacity due to nutrient removal.
Flow Metrers (8)	$ 100,000	50%	$ 50,000	0%	$ -	New flow metering equipment required to closely monitor plant operations.
Pump Control Panels	$ 150,000	50%	$ 75,000	0%	$ -	Upgraded pump controls for additional pumping requirements.
Electrical Work	$ 200,000	50%	$ 100,000	50%	$ 100,000	Additional electrical work required to accommodate plant upgrades.
Re-Route Existing Piping	$ 100,000	50%	$ 50,000	50%	$ 50,000	Additional yard piping required to accommodate plant upgrades.
Subtotal	$ 4,895,000		$ 2,846,300		$ 2,522,500	
Contingency (10%)	$ 489,500		$ 284,700		$ 252,300	
Total Construction Cost	**$ 5,384,500**		**$ 3,131,000**		**$ 2,774,800**	
Engr, Legal, Admin, Finance (6.6%)	$ 979,000		$ 207,000		$ 183,000	Engineering, legal, admin and finance fee on total project is approx 18.2%.
TOTAL ESTIMATED COST	**$ 6,363,500**		**$ 3,338,000**		**$ 2,957,800**	
% COST - CTSB MODIFICATIONS	-		**52%**		**46%**	

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 26, 2008
Plant:	Jersey Shore Borough
Attendees:	Darby Neidig – Metcalf & Eddy Keith Zerby – Jersey Shore Borough Eric Moore – Larson Design Group
Prepared by:	Darby Neidig
Project. No.:	60044954/425

Existing Facility / Flow Contributions – The existing facility is an activated sludge process treating an average daily flow of 0.55 to 0.60 MGD. Influent conditions are roughly 30 mg/l N and 5 mg/l P. The existing infrastructure was constructed in the mid 1950's and early 1970's, and is approaching the end of its life cycle. The Borough Engineer believes that the existing clarigesters may need to be completely replaced within 10 to 15 years. The treatment components are operating adequately and are replaced / rehabilitated on an as-needed basis.

Two types of wastewater must be considered when evaluating possible plant upgrades. The first is high N residential septage and the second is high salinity "frack" water produced during natural gas well drilling.

Cost Estimate – No immediate capacity or nutrient removal upgrades are intended for this facility. Aside from general facility improvements (approx $150K), any significant construction costs over the next 5 - 10 years would be directly attributed to BNR required upgrades. The Operator and Engineer believe that it would be detrimental to extensively modify or retrofit the existing infrastructure because to its age.

The projected cost for upgrading the system to maintain current limits is roughly $3M, whereas upgrades to meet BNR are estimated at $10.6M. BNR related upgrades will greatly raise the annual O&M and utility costs due to a significant increase in aeration costs, chemical costs and sludge production.

BNR Driven Upgrades – As described above, many of the components of the existing system are likely entering the last decade of their service life. The existing facility functions well and, aside from routine maintenance and periodic equipment changes, is not in need of any significant upgrades. Any new treatment units would be driven entirely by BNR requirements. It is believed that the existing system infrastructure could not support a substantial retrofit due to the complexity of the new treatment components, the existing facility configuration and the lack of available space on site. Several

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CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY
FOR
LEGISLATIVE BUDGET & FINANCE COMMITTEE
OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 21, 2008
Plant:	Lackawanna RBSA-Throop WWTP
Attendees:	Michael Matechak, Facilities Engineer Mike Merchanti, Plant Superintendent Dominic Schilacchi, Executive Director
Prepared by:	Andrew Arsenault
Project. No.:	60044954/425

Existing Treatment Plant

The Throop WWTP is currently a conventional activated sludge plant. The plant consists of two grit removal channels with chain and flight scraper mechanisms and dewatering screws, one mechanical band screen, and three raw sewage list pumps. After the lift pumps, the flow enters four rectangular settling tanks, for aeration tanks with ceramic disc fine-bubble diffusers, four rectangular secondary clarifiers, and two chlorine contact tanks. Throop is currently chlorinating by an automated sodium hypochlorite feed disinfection system followed by an automated sodium bisulfite dechlorination feed system.

Waste sludge from the secondary settling tanks, and primary sludge from the primary settling tanks are sent to a dissolved air floatation sludge thickener with polymer coagulation, and then to two anaerobic digester tanks. Biosolids from the anaerobic digester tanks are then sent to a belt filter press for dewatering and sent to either a landfill or is land applied.

Design annual average flow per current DEP WQM permit – 7.00 MGD

Estimated average flow in 2010 is 6.06 MGD

Effluent TN values – Monthly total – June 2008 – 29,424 lbs/month

Effluent TP values – Monthly total – June 2008 – 3,543 lbs/month

Proposed Upgrades

Mike Matechak, the facilities engineer, filled out the survey.

Throop WWTP is converting the existing primary clarifiers, aeration tanks and secondary clarifiers to a 4-stage Bardenpho process. They are also planning on constructing 4 new circular clarifiers for secondary clarification, and upgrading the solids handing facility. They are upgrading the current belt filter presses with new presses. The headworks facility will also be upgraded.

The Bardenpho process will consist of 4 process trains. The 4 primary clarifiers will be the 1st stage of the Bardenpho process, and become anoxic tanks. The existing aeration tanks will be converted to the 2nd stage and become fine bubble aerators. The existing secondary clarifiers will become the 3rd and 4th stages, and become an anoxic zone followed by an aeration zone. A new secondary clarifier will follow each process train.

The chlorine contact tanks will increase tankage to be able to contain the new capacity.

The BNR upgrade will concurrently increase plant design capacity from 7.0 to 10.0 MGD.

There were multiple upgrade options that were considered, which included the 4-stage Bardenpho process, the Bardenpho process with membrane bioreactors, and the MLE with denitrification filters. These options were evaluated in detail, including dynamic modeling, as they were determined to be capable of achieving the new nutrient removal limits based on the LBRSA's wastewater characteristics. Further refinements of these options were evaluated including Bardenpho process with primary clarifiers, Bardenpho process without primary clarifiers, and increasing existing tank wall heights to achieve the desired capacity vs. adding a new treatment train.

The 4-stage Bardenpho process w/o primary clarifiers was selected as the most cost effective means of achieving the nutrient removal limits.

Nutrient Trading Program

The nutrient trading program was considered. However, it wasn't cost effective for the amount of credits needed. The nutrient trading program was analyzed when they completed the 537 plan for the DEP. Mike did state that they plan on participating with the program by trading internally with the two other plants owned and operated by Lackawanna River Basin Sewer Authority.

LRBSA owns Throop WWTP, Archibald WWTP, and Clinton WWTP. Of the three WWT plants, Throop is the largest. Archibald WWTP is 6.0 MGD while Clinton WWTP is 0.7 MGD.

Schedule

Throop WWTP is in Phase I and must comply by 2010. Archibald WWTP is in Phase 2, while Clinton WWTP is in Phase 3.

It is the authority's goal to finish the construction of Throop WWTP so they are able to sell credits to both Archibald and Clinton, before Phase 2 and Phase 3 begin. Construction start date, for Throop, is dated for March 2009. It is to be completed by September of 2009.

The authority is currently in the process of submitting part 2, of the application, to DEP for completion of final design.

Cost and Financing

The planning/study cost of $88,900 has already been spent, while 80% of $1,931,000 for design, has already been completed. A construction cost of $17,451,000 is estimated for improvements related to N and P removal. An over construction cost was estimated to be around $20,212,000. However, the additional $2,761,000 are work items that include raising process tank walls, expanding chlorine contact tanks, increasing influent sewage pumping capacity plus the incremental increases in secondary capacity and headwork's equipment capacity. These additional costs are related to the capacity increase from 7.0 to 10.0 MGD.

The project will likely be financed by a bond issue. The LRBSA are also pursuing state grant funding that's made available by the passage of Senate Bill No. 2 included in the adopted state budget.

A rate increase became effective March 2008 in which they increased the annual residential fee from $180 to $240. This was as a result of design costs currently being incurred as well as future construction costs to be incurred. Rates will be reevaluated once final project costs are determined. The last time rates increased was in 1992, where it went from $120 to $180.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	September 24, 2008
Plant:	Lancaster, City of
Attendees:	Gary Bowers, Wastewater Supervisor Ralph Eschborn - Metcalf & Eddy
Prepared by:	Ralph Eschborn
Project. No.:	60044954/425

Existing Treatment Plant

The City of Lancaster WWTP consists of Primary clarification plus screening, Secondary treatment using the A/O process (using High Purity Oxygen or "HPO") modified for BNR (Biological Nutrient Removal) operation, Final clarification, Chlorine (gas) Disinfection, sodium bisulfite declorination, and belt filter press dewatering of solids with lime stabilization.

Design annual average flow per current DEP WQM permit – 29.73 MGD

Estimated average flow in 2010 is 25.27 MGD

Effluent nutrient loading – 12 Month Average through July 2008 – Total N (lbs) –

443,909 (72 % of Cap)

Effluent nutrient loading – 12 Month Average through July 2008 – Phosphorus (lbs) – 57,910 (75% of Cap)

Proposed Upgrades

Gary said their facility was modified to operate in a BNR mode in 2004 and is operating comfortably within their cap loads at current flow rates (19-20 MGD). These 2004 improvements were focused on providing an anoxic zone for denitrification and tighter D.O. control and included installation of new return activated sludge (RAS) pumps, meters, mixers, aerators, variable frequency drives and related control panels, a new Programmable Logic Control (PLC) system, motor-operated valves, associated piping, and sealing of the HPO tanks to control oxygen leaks.

They anticipate a growth in average flow from the current 19-20 MGD to 25.27 MGD by 2010, largely due to fulfilling their Long Term Control Plan (LTCP) to minimize Combined Sewer Overflow (CSO) discharges during storm events. They are currently in the planning and early design phases for increasing primary clarification capacity and adding high rate disinfection as a means of dealing with the higher and more fluctuating flows that will result. While some further capital improvements may be required in order to maintain the tight process control required for nitrogen removal while accommodating these increased and more variable flows, they have not been quantified and identified as nutrient removal capital costs at this point in time.

Nutrient Trading Program

Purchasing of nutrient credits was not considered, since the facility is and will be operating below nutrient cap loads for the next several years. Gary said they did discuss the possibility of selling credits, but didn't pursue it. While they are operating comfortably below their cap loads, right now, the increased flow from minimizing CSO discharges will reduce the size of this reserve, and they don't want to risk a potential future NPDES violation.

Schedule

Capital improvements were made in 2004, and have been fully operational since 2006.

Cost and Financing

The nutrient removal upgrades cost $3.7 million (June 2004). The impact of this capital cost is already reflected in user rates.

Project	Cost	Nutrient Related Share of Cost
BNR modifications to A/O process	$ 3.7 million	$ 3.7 million

Adjusted Total Cost = $ 3.7 million
Adjusted Nutrient Related Cost = $ 3.7 million

Adjusted Nutrient Related Percentage of Total = 100 %

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 21, 2008
Plant:	City of Lebanon Authority WWTP
Attendees:	Jim Fraytic, Superintendent Cora A Shenk, Assistant Superintendent
Prepared by:	Nalan Tepe-Sencayir
Project. No.:	60044954/425

Existing Treatment Plant

Two pumps station in the collection systems pumps wastewater into the trunk lines. Wastewater enters the plant through headworks which has self cleaning screens, then gravity grit settlers. Before the primary clarifiers, ferrous sulfate is added in a flash mix tank.

The supernatant is pumped to above ground trickling filter towers followed by secondary (intermediate) clarifiers. The wastewater flows to 4 nitrification tanks. It is aerated by course bubble diffusers. Also mechanical mixing is provided in these tanks. There are 4 final clarifiers, 2 of them have gravity sludge flow, and the newer 2 has pumped sludge flow. They have problems at the sludge flow stabilization from the tanks. They cannot get consistent flow and sludge quality out of 2 independent pairs.

There are conventional sand filters for final polishing, but mostly they do not use the filters. Disinfection is achieved by UV treatment. Old chlorination tanks are used as some kind of post aeration tanks.

Sludge is aerobically digested and filter pressed. Final Class B cake is land applied.

Proposed Upgrades

As part of the BNR requirements, aeration tanks will be converted to MLE and IFAS tanks. They will be configured by raising the tank walls and isolating tanks to split anoxic and aerobic zones. It will have internal recycle to anoxic zone, and methanol will be supplemented additional carbon source. The superintendent didn't like the IFAS idea due to the presence of the media and being not operation friendly but engineer recommended this based on the cost. The other alternative they evaluated was expanding the plant with like-wise processes. But based on the cost efficiency and meeting the target concentrations, the idea was eliminated.

Blower piping and blowers will be replaced as part of the upgrades. This part is somewhat arguable whether it is BNR related or not. They are currently experiencing problems with blowers, because the system is very old and has leaking problems. So the piping would be replaced even for the existing system. But they are changing the piping to be able to isolate air flow to each tank, so based on this; it can be accounted for BNR.

Final clarifiers will be modified as part of the upgrades. As I mentioned earlier, they currently have problems, but meantime the changes are required to be able to operate and manage sludge flow to the new MLE process.

Existing sand filters will be demolished and new denite filters will be installed for further nutrient removal. An expansion of the filter building may be required. They will increase the chemical addition at the flash mix tank to achieve P removal. In addition, they are planning to add ferrous sulfate before the denite filters, if they cannot achieve the limit. They reported that they would comply with 6 mg/L TN w/o the denite filters, but they want to treat further down to 3 mg/L in case limits get stricter.

UV disinfection system will be upgraded too. Since the flow capacity to treatment plant is not being changed, I didn't understand why they would change the disinfection system. The superintendent could not give a certain answer. He told me the UV system capacity will not be enough after the process changes and they will convert the existing chlorination tanks to UV channels.

Improvements to aerobic digester were listed under BNR too. The superintendent did not know the changes to the digestion system. For the sludge processes they will replace the belt filters and add drum dryers to obtain Class B solids. They count this for BNR because it is land applied and farms are accepted as non-point source under the C-bay program. But going from Class B to Class A doesn't necessarily mean that the product has less nutrients.

The power station will be replaced, not BNR related.

Influent TN= 20-35 ppm and TP= 6.5-7.5 ppm

Existing effluent: NH_3=0.1 ppm Nitrates = 25-26 ppm TP= 1-1.5 ppm

Design effluent based on TN = 3 ppm TP = 0.3 ppm

<u>Nutrient Trading Program</u>

They evaluated the nutrient program before starting the design work for the upgrades. Based on the prices at the time they calculated they would pay up to $1.4 million annually to buy credits.

The assistant superintendent, Cora Shenk, sent the following information regarding their nutrient trading calculations.

Comparison current loads to proposed limits

Discharge Parameter	Exceedances to Current Limits	Current Annual Load, lbs*	Proposed Annual Limit, lbs	Exceedance to Proposed Limit, lbs
Total Nitrogen	0	306,455	146,117	160,338
Total Phosphorus	0	21,400	19,482	1,918

*July 1, 2006 to June 30, 2007

At these discharge levels at current credit prices - to purchase necessary Nitrogen credits for annual exceedances, the cost was estimated as $611,000 to $1.4 million ($3.81 -

$9.00). Considering effluent levels and credit prices will probably increase, they pursued an upgrade design instead of buying credits.

However they would consider selling credits after the upgrade since they will reduce the nutrient levels more than compliance levels.

Schedule

They are in Phase I to comply 2010, but the engineer negotiated w/ PADEP and extended the compliance schedule till October 1st, 2012. Preliminary design will be completed by the end of 2008.

Cost and Financing

The cost as $50 million is based on $6 per gallon. It is not based on equipment cost, but only experience on the BNR construction. The superintendent reported that, he estimates $25-30 million of the total cost being BNR related, but they will not have the cost breakdown until preliminary design is completed. Based on the proposed upgrades, $25 million is recommended as nutrient related cost.

They will finance by bonds but will look into grants too. Also starting end of 2008 or beginning 2009, they will start to increase rates. A rate study is being conducted by the engineer. They will increase the rates in stages.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 26, 2008
Plant:	Lewisburg Area Joint Sewer Authority
Attendees:	Bill Drasher - Lewisburg Area JSA Darby Neidig – Metcalf & Eddy
Prepared by:	Darby Neidig
Project. No.:	60044954/425

Cost Estimate – The facility currently operates as an activated sludge process after originally being designed as contact-stabilization. Several treatment components (digester, sludge pumps, heat exchanger, blowers and aeration diffusers, mixers, etc) were modified or upgraded in 2002. The existing equipment is in very good to excellent condition and will not need to be replaced for a significant period. There is nothing to indicate that design capacity (2.42 MGD) will need to be increased. The current average daily flow is 1.1 MGD and the 2010 projected flow is 1.44 MGD. All construction costs for facility upgrades will be as a direct result of BNR requirements. The projected total cost to meet BNR requirements is approximately $9.7MM. LAJSA also estimates that associated O&M related costs (electric, chemicals, solids disposal, etc.) will increase by $100 to $150K / year. Initial estimates indicate a 60% - 70% increase in user rates to fund the improvements. This increase would equate to an average monthly bill increase to nearly $130.

BNR Driven Upgrades – As described above, the existing facility is in very good condition after having gone through a significant upgrade in 2002. Improvements to the existing facility would be driven entirely by BNR requirements. The anticipated upgrades include construction of integrated fixed-film activated sludge (IFAS) treatment components; conversion of existing tankage to create an anoxic zone; installation of new chemical feed systems; construction of denitrification filters; and additional recycle pumps. Construction would likely begin in July 2009 and would conclude in July 2010.

Alternatives - Several other alternatives for BNR were considered. These alternatives were discussed in the Authority's Chapter 94 Report.

Nutrient Credits - The Authority is not currently interested in the nutrient trading program. Concerns exist over the availability and long term cost of credits. LAJSA will opt to upgrade the WWTP to meet BNR requirements. A paper copy of the recently completed nutrient trading survey was provided. Mr. Drasher will complete the survey and return it after consulting with the Authority's engineer.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	September 19, 2008
Plant:	Lower Allen Township Authority (LATA)
Attendees:	John Brossman - LATA Bryce Figdore - Metcalf & Eddy
Prepared by:	Bryce Figdore
Project. No.:	60044954/425

The existing LATA plant liquid treatment process consists of fine screening, influent pumping, primary settling, mechanical surface aerated activated sludge, secondary clarification, and UV disinfection. Phosphorus is precipitated chemically (with alum) in the secondary clarifiers. The primary clarifiers, aeration basins, and secondary clarifiers have two trains each. The site layout was configured to accommodate an expansion to four tanks each (of like-sized tanks). The plant is on the Yellow Breeches, but the plant outfall is actually greater than one mile in length and conveys effluent to the Susquehanna River. Solids are gravity thickened and lime stabilized onsite or hauled offsite to Harrisburg where they are anaerobically digested. About 60-70% of the solids are lime stabilized and sent to agricultural sites for land application; the balance of the solids are sent to Harrisburg for processing.

Mr. Brossman was been actively involved in the Point Source Work Group and pushed for cap loads based on design flows in lieu of projected 2010 flows. Mr. Brossman indicated that LATA had negotiated a later implementation schedule for CBTS compliance in its Chapter 92 Report, but that the negotiated implementation schedule was not accepted by Chesapeake Bay Foundation. Mr. Brossman indicated that LATA is involved in a legal dispute to resolve issues concerning the negotiated implementation schedule.

LATA's upgrades are planned over two phases. The first phase will be solids processing upgrades that converts digestion to ATAD process and adds dewatering by centrifuges. Dewatering will allow future Class A cake to be mixed with Lower Allen Township's leaf compost, and will also expand the radius of feasible disposal sites since biosolids cake would be hauled instead of biosolids. From discussions, it appears that the solids upgrade is partially due to anticipated increased solids load associated with nutrient removal processes, but also partially due to the decreasing agricultural land available for biosolids application.

The second phase of upgrades will be liquid process modifications for nutrient removal. Mr. Brossman indicated that Buchart Horn performed process modeling with BioWin in 2006 with the objective of sizing processes to meet nutrient cap loads. The conclusions were that biological reactor volume needed to be expanded and a new secondary clarifier was required. Mr. Brossman indicated that, in light of potential TMDL from EPA, the liquid process modeling and recommended modifications are being revisited based on 3 mg/L TN and 0.025 mg/L TP. At this treatment level, filtration would be required, and LATA would need to build effluent pumping facilities because of additional headloss associated with filtration.

Mr. Brossman indicated that the reported nutrient removal-related estimated cost of $20 million includes the cost of the solids processing upgrades and liquid treatment upgrades, but that the cost for the liquid treatment upgrades was reported based on estimates for "cap load level of treatment" and not "TMDL level of treatment". Mr. Brossman indicated that the reported costs are low, because LATA's upgrades would be built to meet the more stringent "TMDL level of treatment". Given the considerations that 1) the solids processing upgrades seem to be driven partially by nutrient removal and partially by changing conditions end use disposal options and 2) the reported costs for liquid process modifications are low because LATA would install limit-of-technology processes to meet "TMDL level of treatment", these considerations seem to negate each other, and absent more detailed cost breakdown, $20 million as reported for nutrient removal related costs should be used. However, overall project cost should be adjusted as follows to 1) lower nutrient removal cost percentage and 2) increase overall total project cost.

Project	Cost	Nutrient Related Share of Cost
Solids Upgrade	$10 million	$5 million
Liquid Upgrade	$15 million	$15 million

Adjusted Total Cost = $25 million
Adjusted Nutrient Related Cost = $20 million
Adjusted Nutrient Related Percentage of Total = 80%

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	September 9, 2008
Plant:	Millersville Borough STP
Attendees:	Leslie L. McMullen, Plant Supt. Ralph Eschborn - Metcalf & Eddy
Prepared by:	Ralph Eschborn
Project. No.:	60044954/425

Existing Treatment Plant

The Millersville STP consists of a Rotomat fine screen, Pista grit chamber, Primary settling tank, 2 Sequencing Batch Reactor (SBR) tanks, Final effluent tanks, disinfection with chlorine (gas), aerobic sludge digesters and dewatering with a 2 meter belt filter press.

Design annual average flow per current DEP WQM permit – 1.85 MGD

Estimated average flow in 2010 is 0.71 MGD

Effluent nutrient conc. – Average for 1st Half 2007 -Total N (mg/l) – 8.0 (51 % of Cap)

Effluent nutrient conc. – Average for 1st Half 2007 -Total P (mg/l) – 1.3 (62% of Cap)

Proposed Upgrades

Les stated that they have had reasonably good success nitrifying and removing nitrogen since implementing improved Dissolved Oxygen (D.O.) control in November 2006. Largely due to operating at flow and influent loading levels that are less than one-half of design, they are routinely achieving effluent loadings of Total Nitrogen (TN) and Phosphorous (P) in the 50-60% range of their cap loads, which are based on design flow and TN and P effluent concentrations of 6 and 0.8 mg/L, respectively.

The Millersville Borough service area is largely built-out, and only modest growth is anticipated for the foreseeable future. As a result, the only capital improvement the facility is planning to install is a SCADA (centralized, electronic data acquisition and management) system to further improve D.O. control. The overall cost for the system is estimated at $50,000 (in mid-2008 dollars).

Nutrient Trading Program

Since they are meeting their cap loads today and for the foreseeable future, Millersville has not considered the purchase of nutrient credits. Conceivably, Millersville could contemplate selling credits – say, 5-10,000 lbs, N/yr. Providing 10,000 lbs in credits would require setting aside 11,100 lbs/yr to allow for the reserve ratio (10%), leaving 5450 lbs per year between current effluent TN loading plus credits and the annual cap load, or about a 40% safety factor. At 5000 lbs, N/yr, this safety factor would increase to over 60%. Les indicated that they have not considered this prospect, and are unlikely to do so.

Schedule

Since they are already meeting their cap loads, they are not under a deadline to implement the SCADA portion of their process control system; however, they anticipate implementing SCADA in the next year or two to ensure compliance.

Cost and Financing

The modest capital cost of the SCADA system will be funded out of current revenues and no change in operating costs are anticipated as a result of implementing this final phase of nutrient removal. User rates were actually decreased recently, and no change to the user rate structure is planned, as a result of implementing nutrient removal.

Project	Cost	Nutrient Related Share of Cost
SCADA (improved control)	$50,000	$50,000

Adjusted Total Cost = $50,000
Adjusted Nutrient Related Cost = $50,000
Adjusted Nutrient Related Percentage of Total = 100%

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	September 19, 2008
Plant:	Northeastern York County Sewerage Authority (NEYCSA)
Attendees:	Tom Beakler - NEYCSA Bryce Figdore - Metcalf & Eddy
Prepared by:	Bryce Figdore
Project. No.:	60044954/425

The NYCSA plant site has constraints in that space is extremely limited. The site is essentially built-out, and is bounded by a steep hill on one side and a creek on the other side.

The existing plant liquid treatment process has two trains, each consisting of a primary clarifier, trickling filter and secondary clarifier. The trickling filters are different sizes and elevations; therefore the trickling filters are loaded at different rates. Influent wastewater goes through a dated headworks with screening, grit removal, flow measuring, and rag removal prior to influent pumping to the trickling filters. Solids are anaerobically digested and land applied on Authority-leased farmland. This practice will continue after the planned upgrades.

The proposed upgrades call for a new process tank by Aero-Mod to be built on top of the footprint of the existing headworks. Land has been acquired to expand the site to accommodate new plant and relocation of the headworks. One of the primary clarifiers will be converted to a fermentation tank to enhance biological phosphorus removal (prior to the Aero-Mod anaerobic zone). Aero-Mod will give NYCSA a process guarantee of 6 mg/L TN and 0.8 mg/L TP. NYCSA is proceeding with design and construction of the proposed upgrades to meet nutrient cap load limits, although NYCSA is aware of the potential for a more stringent TMDL being considered by EPA.

NYCSA investigated alternatives to the Aero-Mod process whereby the existing tankage was re-used to a greater degree. NYCSA indicated that these alternatives were eliminated from consideration because: their capital cost was greater, their operational complexity was higher, and the plant would not be able to treat current flow during construction.

On review of NYCSA's completed survey, the headworks replacement did not appear to be a nutrient-related cost. After visiting the site, it is apparent that the headworks replacement was driven by the need to fit new nutrient removal tankage on a tight site, and relocation and replacement of the headworks was not avoidable. Therefore, it is reasonable to include the headworks as a nutrient-associated cost. Given this conclusion, and based on site visit discussion and the level of detail available in the survey responses, NYCSA's reported cost of $4.8 million can be classified as 100% nutrient related.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 27, 2008
Plant:	Northern Lancaster County Authority
Attendees:	Tim Myers, Superintendent
Prepared by:	Nalan Tepe-Sencayir
Project. No.:	60044954/425

Existing Treatment Plant

The existing plant is a conventional activated sludge type that nitrifies ammonia nitrogen and uses chemical precipitation for removal of phosphorus. Hydraulic capacity is 0.45 MGD and organic capacity is 935 pounds of BOD per day.

The influent flows by gravity through a bar screen. From the wet well, flow is pumped to primary treatment by two submersible influent pumps. The flow is split to two circular primary clarifiers.

Primary clarifiers are followed by two parallel aeration tanks, conventional activated sludge system. BOD removal and nitrification is achieved in aeration tanks. Aluminum sulfate is added at this stage for phosphorus precipitation.

There are two parallel circular clarifiers that receive mixed liquor (aeration tank contents made up of primary effluent and return activated sludge from secondary clarifiers). Final clarifier effluent flows to the chlorine contact tanks where the final effluent is disinfected.

The original design included sand filters for final polishing the final clarifier effluent. The filters have not needed to produce effluent quality required to satisfy effluent criteria and have remained out of service since 1982.

The sludge is aerobically digested then in the reed beds; sludge is further stabilized and dewatered. Reed bed sludge is usually hauled to landfills when reed beds need to be cleaned.

They do not sample the influent for N and P, he did not know the levels.

Existing effluent TN=47.25 ppm, TP=1.3 ppm

Effluent based on last DMR; TN=47.25 ppm TP=1.3ppm

August DMR= 58,968 lb TN/yr (They are reporting annual load each month calculated based on most recent 12 months)

Compliance limits, TN=6 ppm, TP, 0.8 ppm.

Proposed Upgrades

They have evaluated three processes, Vertical Loop Reactors (VLR), A^2O and Sequencing Batch Reactor (SBR). The Probable Construction Cost Opinion for SBR and VLR were $4,842,758 and $4,595.055.00, respectively. The VLR process was recommended because it is equally efficient and less costly to construct, while also preserving valuable site space for future expansion and upgrading at the plant.

Along with the BNR upgrades, the capacity of the plant will be increased to 0.65 mgd from 0.45 mgd.

Currently, they have just a bar screen, the new plant will have a headworks with grinder and grit removal. The location for headworks is not decided yet, they want to put it before the influent pumps, but because of elevation issues, it would be 30' deep. They may locate it between the pumps and primary clarifiers (future anaerobic tanks)

A VLR at the plant will employ four reactors in series. The first reactor will be operated in the anaerobic mode. There are two existing primary circular clarifiers each with a capacity of 27,000 gallons. After modification to plug flow, each unit will have a capacity of 20,000 gallons and each will be equipped with mixers. All influent and return activated sludge will be treated under anaerobic conditions in these units prior to mixing with influent just upstream of the anoxic reactor. Denitrification occurs in the anaerobic reactor.

The second reactor would be operated in the anoxic mode. Air containing oxygen would be applied by disc-type mechanical aerators and by diffused aeration. Air containing oxygen is applied to the aerator, but the dissolved oxygen concentration is near zero, so that there is no residual dissolved oxygen. The tank is 50' long, 30' wide, and 18' deep. Anaerobic tank effluent and influent are fed to this tank.

The third reactor would be operated in the anoxic to aerobic mode. Mechanical disc aeration and diffused aeration would be operated to maintain dissolved oxygen between 0.0 mg/L and 1.0 mg/L concentrations. This application would utilize the existing aeration tank 50' by 25' by 14.9', converted to a VLR tank.

The fourth reactor would operate completely under aerobic conditions with dissolved oxygen ranging in concentration between 1.0 and 4.0 mg/L. This tank would be an existing aeration tank 50' by 25' by 14.9' converted to a VLR tank. Each VLR reactor will be divided into an upper and lower zone by a horizontal divider baffle for the full length of the reactor tank. Coarse air bubbles are introduced in the bottom zone of each VLR reactor.

The coarse bubbles take a lengthy pass under the horizontal baffle with the baffle preventing air bubbles from rising to the surface. Bubble residence time is greatly increased, making air available much longer than in conventional aeration tanks where air bubbles rapidly rise to the surface. The upper zone of the VLR is equipped with high-efficiency disc aerators which feed air to the activated sludge and maintain the velocity of flow to loop around the divider baffle through the upper and lower zones. VLR oxygen transfer of the two systems is comparable in efficiency to the most efficient fine bubble systems. Methanol might be added if they cannot achieve the limits.

Phosphorus will be removed biologically by luxury uptake and, if necessary, chemical precipitation. In the second basin, phosphorus removal by "luxury uptake" occurs under the same conditions that promote nitrogen removal through denitrification

The plant has two existing 25' diameter, 12' deep clarifiers and they being upgraded now. For adequate final clarifier capacity, one additional 35' diameter, 14' deep clarifier would be needed along with a mixed liquor flow division box and return activated sludge pumping facilities.

Likewise, an aerobic digester will be built for the expansion. Chlorination system will be converted to UV system.

Cost of BNR

The engineer provided a cost breakdown for the project. Overall construction cost was estimated as $5,206,032 and BNR related cost was estimated as $2,139,131. Actually they have done a good job on identifying what is expansion related and what is BNR related. Modifications to existing aeration tanks are solely BNR. If it is for both expansion and BNR, they designated 50% of the cost to BNR. In my opinion that ratio should have been 2/3, because, they are adding third tank for the expansion but the rest would not be changed if there is no BNR requirements. That would raise the overall BNR related construction to about $2.5 million.

O&M cost will increase with methanol addition and increase in alum use for P removal.

Nutrient Trading Program

Mr. Myers told me he did not believe the Nutrient trading program would work, he described it as a "nightmare". The biggest issue would be finding the farmers to work with. In Lancaster area most of the farmers would not want to be involved in government contracts.

Schedule

They are in Phase 3 and needs to comply by 2013. The project is in design and they are expecting to start construction in 2009 and complete by 2011.

Financing

They will apply state grants and possibly will get a bank loan. The rate increase is not known, but will be significant. The most recent one was in January 2006, they had to borrow $1.6 million for sewer extensions.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY
FOR
LEGISLATIVE BUDGET & FINANCE COMMITTEE
OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 21, 2008
Plant:	Shippensburg
Attendees:	Charles Music, Don Levine
Prepared by:	Brian Aylaian
Project. No.:	60044954/425

The existing plant consisted of standard primary and secondary treatment and a coarse tertiary filter with carbon-based media. The Council of Shippensburg, according to Charles, decided to be proactive regarding BNR treatment and that is why they are ahead of the regulations.

Charles is still optimizing the 5 stage BNR upgrade constructed and commissioned more than a year ago. The upgrade consisted of the following:

1. Conversion of their existing aeration basin to a 5 stage BNR process (Siemens version of Bardenpho)
2. Adding new duplicate 5 stage BNR process tank
3. Addition of new lime system and upgrade of lime building
4. New carbon source feed system

There were only minor upgrades not related to BNR ($200k as noted in survey). Due to the usurping of tank volume for anaerobic and anoxic stages of the 5 stage, Charles contends that there is no expansion of treatment in the BNR upgrade. Due to excellent performance thus far, Charles believes that with optimization the new plant will be likely able to be upgraded to a higher flow rate for organic load, but not hydraulically as the secondary clarifiers were not upgraded in the BNR project. Thus one could argue that the upgrade provided the plant with additional treatment capacity even though technically it was not a capacity upgrade. Until they get the plant stabilized it would be hard to determine the extent of the excess treatment capacity. It is my recommendation that we use what was submitted in the survey as the BNR-allocated costs.

With regard to the trading program, the Shippensburg Council did not want to participate in any way. They believed that the program was too new and too risky. One problem is how credits will be negotiated for the long term. Charles stated that the trading contracts were supposed to be renegotiated each year. If a plant upgrades and takes credits for only a year, what happens to the next year? The threat of no long term stability makes the problem unattractive. This same problem works on the supply side also.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	September 2, 2008*
Plant:	Springfield Township York County Sewer Authority (Seven Valleys, PA)
Attendees:	David Davidson, John Leen (CS Davidson, for Township)
Prepared by:	Brian Aylaian
Project. No.:	60044954/425

* Authority and engineer declined site visit; information below acquired through e-mail and phone conversations.

Information is limited because Authority and Engineer declined site visit, however, breakout of nutrient related costs was discussed and revised. First column below is a breakdown of reported costs provided by John Leen, PM of project. Second column are adjustments based on further correspondence.

DESCRIPTION **COST**

Post SBR Equalization Tank	45 feet wide x 32 feet long x 11 feet high	All	BNR
concrete		$ 540,800.00	$ 540,800.00
excavation		$ 150,000.00	$ 150,000.00
Building addition (Aqua Disc Filters need to be covered)		$ 401,000.00	$ 401,000.00
Aqua Filters-2 each w/4 Discs per unit			
includes Aqua Disc Controls--AB Panelview 550 Touch Screen		$ 350,000.00	$ 350,000.00
Filter pumps-ADF @ 486 GPM and MDF @ 545 GPM		$ 50,000.00	$ 50,000.00
Aeration system - 3 - 50 HP Blowers w/fine bubble diffusers		$ 200,000.00	$ -
Supplemental carbon equipment for denitrification		$ 36,000.00	$ 36,000.00
Coarse Solids Removal unit (screenings unit)		$ 150,000.00	$ -
Chemical feed equipment - addition of alum to digester supernatant		$ 10,000.00	$ 10,000.00
includes chem feed pump and piping			
Utility water - filter backwash		$ 75,000.00	$ 75,000.00
Yard piping		$ 75,000.00	$ 75,000.00
Electrical		$ 150,000.00	$ 150,000.00
Plumbing & Heating for building addition		$ 60,000.00	$ 60,000.00
Upgraded Aqua Process Control Panel		$ 50,000.00	$ 50,000.00
SBR pH monitoring equipment		$ 20,000.00	$ 20,000.00
Subtotal		$ 2,317,800.00	$ 1,967,800.00
Contingency - 15 %		$ 347,670.00	$ 295,170.00
Engineering & Inspection - 12 %		$ 319,856.40	$ 271,556.40
Legal - 4 %		$ 106,618.80	$ 90,518.80
Total		$ 3,091,945.20	$ 2,625,045.20

The coarse solids removal is not nutrient removal related. When I spoke to David, he mentioned to me that the aeration system was to be replaced by the request of operations, not due to age or performance (only 12 years old). Thus we can remove that too. Everything else is nutrient removal related. The second column reflects a truer nutrient related cost of $2.6M.

CHESAPEAKE BAY TRIBUTARY STRATEGY COMPLIANCE COST STUDY FOR LEGISLATIVE BUDGET & FINANCE COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

SITE VISIT MEMORANDUM

Date of visit:	August 20, 2008
Plant:	Municipal Authority of the Township of Union (MATU)
Attendees:	Fred Fultz – MA of the Township of Union Kevin Nester – CET Engineering Services Darby Neidig – Metcalf & Eddy
Prepared by:	Darby Neidig
Project. No.:	60044954/425

<u>Flow Conditions / Industrial Contribution</u> – MATU lost a major industrial contributor in 06/2008 and is slated to lose another in 11/2008. Flow characteristics will change from highly industrial (high P) to primarily domestic. No increase in flow capacity is anticipated at the facility.

<u>BNR Driven Upgrades</u> – The Authority's NPDES permit requires P removal to 2 mg/L by 12/2008. The pending CBTS BNR level for P will be 0.8 mg/L. A TMDL study may occur in 2015. The results of this study may lower the effluent levels even further.

A cost comparison of facility upgrades required to meet each discharge limit was completed. It was determined that the facility would be upgraded to meet the NPDES requirements. The Authority believes that the P loading will be significantly reduced upon closure of the 2nd industrial facility. This would reduce the magnitude of upgrades required to meet the CBTS BNR cap. Upgrades to meet anticipated limits imposed by a TMDL study were significantly higher and thus were not considered at this time.

<u>Cost Estimate</u> – No capacity or nutrient removal upgrades were intended for this facility prior to CBTS. Aside from a small portion for general facility improvements (approx $100K), all construction costs can be directly attributed to nutrient removal requirements. The facility is in very good condition and experiences few operational problems aside from ragging issues and variable flow makeup as a result of the local dairy industry.

The existing plant upgrades required to meet NPDES limits is $400K. This work includes construction of new screening facilities ($200K) and new chemical storage and dosing for Phosphorous removal. This $400K to meet NPDES limits would have been required as a result of nutrient removal requirements, thus it can be assumed that these upgrades can be attributed to CBTS.

The total cost of nutrient related improvements is $3,362,400. As mentioned previously, this entire cost, with exception to the $100K required for general improvements, can be attributed to nutrient related upgrades. These upgrades include a filtration system, chemical P removal, screening, an aerobic digester, modification of sludge storage building and relocation of plant outfall to improve steam mixing.

Alternatives - Several other alternatives for nutrient removal were considered. These alternatives were discussed in Chapter 4 of a feasibility report to assess facility improvements to meet BNR guidelines. This chapter was returned with the original survey.

Nutrient Credits - The Authority is not currently interested in the program. Concerns exist over availability and long term cost of credits. In addition, the NPDES permit is based upon a monthly loading, whereas the CBTS cap load program is based upon a yearly cycle. In theory, the Authority could meet their yearly CBTS cap load limits, but fail to comply with several monthly limits established by their NPDES permit. The Authority will upgrade the WWTP to meet NPDES-level requirements. Additional removal may entitle the Authority to sell nutrient credits.

APPENDIX E

Point Source Survey Questions and Summary of Responses, and Response Details

Appendix E

Point Source Survey Questions, Summary of Responses,

and Response Details

The following includes the Point Source (PS) survey questions and summarizes the results.

1) What is your level of awareness of the Pennsylvania's Nutrient Trading Program (PANTP)?

Over 57% of respondents answered that they were aware of the program but were not considering trades. Only 17% responded that they were considering trades, while 26% said that they were aware of the program but didn't know the details. No respondents answered that they were not aware of the program.

2) Where did you get your information about PANTP?

Some common responses: PMAA & PADEP Workshops, Nutrient Reduction Workshops, web sites, PADEP, Red Barn, all available sources, internet, seminars, DEP Meetings, PMAA Meetings, consulting engineers, association reports, PADEP websites, trade reading, PADEP website, magazine articles, PWEA, PRWA, PADEP Secretary meetings, mailings, media, and legal bulletins.

3) What do you think are typical prices offered for N and P credits in your experience?

Price estimates for nitrogen values ranged from less than $2 to $10 per pound per year. The most commonly chosen dollar amount was $9, with a response of 25% of respondents. A vast majority of respondents (68%) estimated the values of nitrogen between $7 and $10 per pound.

The most common estimate for the cost of a yearly pound of phosphorus was $4, with 25% of respondents giving this figure. The majority of answers, 67%, were between $4 and $7 per pound.

No respondents estimated typical prices of nitrogen or phosphorus above $10 per pound. Only 4% and 8% of respondents estimated nitrogen and phosphorus (respectively) prices below $2 per pound.

4) Where did you get your information about credit prices?

Some common responses are workshop discussions, NutrientNet website, no information at all, talking to wwtp personnel, articles, classrooms, PADEP, Red Barn, all available sources, PMAA, PADEP website, consulting engineers, other agencies, PWEA, PRWA, magazines, no have good information on credit cost because no one knew anything...but almost all of the PADEP Personnel were in favor of it, don't remember, and trading price check.

5) What is your level of understanding about how the program works?

Most of the respondents, 76%, described themselves as having either a moderate level of understanding or little to no understanding. Only 24% reported that they had either a good understanding or a very good understanding.

6) Are you more concerned about nitrogen load or phosphorus load?

Most respondents, 50% said they were equally concerned about both nitrogen and phosphorus; 47% said they were more concerned about nitrogen. Only 3 % said they were more concerned about phosphorus. No respondents answered that they were concerned about neither. No respondents answered that they did not know.

7) How many annual N credits would you need to meet regulations?

A range of responses from 0 to 568,060 pounds, to don't know or not determined.

How many annual P credits would you need to meet regulations?

A range of from 0 to 114,184 pounds, to don't know or unknown.

8) What is your level of willingness to explore the option of purchasing N credits?

Respondents were somewhat willing to explore the option of purchasing nutrient credits, with 47% responding accordingly; 11% described themselves as very willing, while 29% were not willing to explore the option; 13% responded that they did not know.

9) Please score the following factors from Not Important (1) to Very Important (5) in your consideration of the purchase of credits.

The highest scoring factors were "perceived uncertainty of present of future value of credits," "perceived stability/reliability of the program," "cost of credits," and "availability of credits." Each scored about 4.3 on the scale from 1-5 with 1 being not important and 5 being very important. Lower scoring factors included "availability of information" (3.97), "perceived complexity of program" (3.85), "purchasing/bidding requirements" (3.71), and "timing of improvements vs. credit purchase" (3.41). It should be noted that each factor received more responses in the "very important" column (5) than in any other column.

10) What is the highest viable price your operation would consider for nutrient credits?

For nitrogen, the most common answer was $2 per annual pound with 24%. More than 40% of the respondents gave a value of equal to or less than $3 per annual pound, while 28% gave a value in the $5-$7 range. Only 8% responded with higher values than $7.

11) How certain and stable do you perceive the nutrient trading program to be?

Respondents overwhelmingly responded that the program was uncertain and unstable, with 86% choosing either "somewhat uncertain and unstable" (43%) or "highly uncertain and unstable" (43%). Just over 8% described the program as somewhat certain and stable, while 3% described it as very certain and stable; 6% of respondents said they did not know.

12) The current availability of credits compared to our anticipated need for load reductions is:

Those responding, "don't know" were 45%, while 34% responded "less than sufficient." Only 20% responded that the current availability was sufficient.

13) How well established do you perceive the nutrient trading program to be?

Respondents described the status of the program as either “incomplete with unproven success” (57%), or “somewhat incomplete” (26%). Only 14% perceived the program as either “somewhat well established” or “very well established”.

14) Information about costs and availability of credits is well documented.

Most (77%) of respondents disagreed with this statement, and 14% said they did not know; 7% agreed.

15) Credit purchase is a stopgap measure, and not a sustainable long-term investment.

Most (86%) of respondents agreed with this statement; only 3$ disagreed, and 11% said they did not know.

16) Future total maximum daily load (TMDL) limits may make credit purchases obsolete.

Most (66%) of respondents agreed with this statement, while 23% said they did not know, and 11% disagreed.

17) The number of credits available in future years is undefined, resulting in a risk of future non-compliance.

Almost all (91%) of respondents agreed with this statement, 9% did not know. No respondents disagreed.

18) Investment in nutrient credits might make sense if future technologies promise a decrease in the cost of plant improvements.

Most respondents (63%) agree and 17% disagree with this statement.

19) Does it matter to you how credits you purchase are generated?

The way credits are generated mattered to 39% of respondents, and did not matter to 50%.

20) Which of the following methods of generating credits would you prefer?

Most respondents (58%) preferred the reduction of nutrients (BMPs) as a method of generating credits, and only 3% preferred manure export, while 39% didn’t care.

21) What would be your preferred method for acquiring credits?

A majority of the respondents (62%) preferred acquiring credits from a “bank”, while 29% were willing to deal privately with a farmer or other municipality, and 9% didn’t care. None were willing to deal with broker.

22) The complexity of the PANTP is an obstacle to our participation in the program

Over 62% believe that the complexity of the PANTP is an obstacle to participation, and 21% disagree.

23) Purchase of credits is not necessary because nutrient effluent reduction modifications are planned to coincide with other necessary plant upgrades already scheduled.

Most respondents (47%) strongly agree or agree that nutrient will coincide with plant upgrades and that purchasing credits is not necessary. Only 32% disagree, and 18% don’t know.

24) It is valuable to have the option of buying credits whether or not those purchases finally get made.

Over 71% strongly agree or agree that having the option of buying credits is valuable. Only 12% disagree or strongly disagree.

25) We have used the PADEP's NutrientNet website to view credits currently available to trade.

Over 59% have not used the PADEP's NutrientNet website to view available credits, and 38% have viewed credits on the website.

The following includes the Survey Questions and Responses.

1. What is your level of awareness of the PA Nutrient Trading Program (PANTP)?		
	Response Percent	**Response Count**
a) Aware but don't know details	26.2%	11
b) Aware and considering trades	16.7%	7
c) Aware but not considering trades	**57.1%**	24
d) Not aware	0.0%	0
	answered question	**42**
	skipped question	**0**

2. Where did you get your information about the PANTP?	
	Response Count
	34
answered question	**34**
skipped question	**8**

3. What do you think are typical prices offered for N and P credits in your experience?											
	<2	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**>10**	**Response Count**
N ($/lb/yr)	3.6% (1)	3.6% (1)	3.6% (1)	0.0% (0)	10.7% (3)	10.7% (3)	14.3% (4)	10.7% (3)	**25.0% (7)**	17.9% (5)	0.0% (0)	28
P ($/lb/yr)	8.3% (2)	4.2% (1)	8.3% (2)	**25.0% (6)**	16.7% (4)	12.5% (3)	12.5% (3)	0.0% (0)	4.2% (1)	8.3% (2)	0.0% (0)	24
											answered question	**28**
											skipped question	**14**

4. Where did you get your information about credit costs?		
		Response Count
		33
	answered question	**33**
	skipped question	**9**

5. What is your level of understanding about how the program works?			
		Response Percent	**Response Count**
a) Very good understanding		5.3%	2
b) Good understanding		18.4%	7
c) Moderate level of understanding		**57.9%**	22
d) Little to no understanding		18.4%	7
	answered question		**38**
	skipped question		**4**

6. Are you more concerned about nitrogen load or phosphorus load?			
		Response Percent	**Response Count**
a) P		2.6%	1
b) N		**50.0%**	19
c) Both equally		47.4%	18
d) Neither		0.0%	0
e) Don't know		0.0%	0
		answered question	**38**
		skipped question	**4**

7. How many annual credits would you need to meet regulations?			
		Response Percent	**Response Count**
N (lbs/yr)		**100.0%**	32
P (lbs/yr)		93.8%	30
	answered question		**32**
	skipped question		**10**

8. What is your level of willingness to explore the option of purchasing N credits?			
		Response Percent	**Response Count**
a) Very willing		10.5%	4
b) Somewhat willing		**47.4%**	18
c) Not willing		28.9%	11
d) Don't know		13.2%	5
	answered question		**38**
	skipped question		**4**

9. Please score the following factors from Not Important to Very Important in your consideration of the purchase of credits.

	Not Important				Very Important	Rating Average	Response Count
Availability of information	8.3% (3)	5.6% (2)	13.9% (5)	22.2% (8)	**50.0% (18)**	4.00	36
Perceived complexity of program	11.4% (4)	8.6% (3)	11.4% (4)	25.7% (9)	**42.9% (15)**	3.80	35
Timing of improvements vs. credit purchase	16.7% (6)	11.1% (4)	13.9% (5)	27.8% (10)	**30.6% (11)**	3.44	36
Cost of credits	8.3% (3)	2.8% (1)	0.0% (0)	22.2% (8)	**66.7% (24)**	4.36	36
Purchasing/bidding requirements, etc.	11.1% (4)	2.8% (1)	19.4% (7)	30.6% (11)	**36.1% (13)**	3.78	36
Perceived stability/reliability of program	8.1% (3)	2.7% (1)	0.0% (0)	21.6% (8)	**67.6% (25)**	4.38	37
Availability of credits	5.6% (2)	2.8% (1)	2.8% (1)	33.3% (12)	**55.6% (20)**	4.31	36
Perceived uncertainty of present or future value of credits	5.6% (2)	2.8% (1)	5.6% (2)	22.2% (8)	**63.9% (23)**	4.36	36
						answered question	**37**
						skipped question	**5**

10. What is the highest viable price your operation would consider for nutrient credits?												
	<2	2	3	4	5	6	7	8	9	10	>10	Response Count
N ($/lb)	16.0% (4)	**24.0% (6)**	16.0% (4)	8.0% (2)	12.0% (3)	8.0% (2)	8.0% (2)	4.0% (1)	0.0% (0)	4.0% (1)	0.0% (0)	25
P ($/lb)	**40.0% (10)**	20.0% (5)	8.0% (2)	4.0% (1)	12.0% (3)	4.0% (1)	8.0% (2)	0.0% (0)	0.0% (0)	4.0% (1)	0.0% (0)	25
											answered question	**26**
											skipped question	**16**

11. How certain and stable do you perceive the nutrient trading program to be?		
	Response Percent	Response Count
a) Very certain and stable	2.9%	1
b) Somewhat certain and stable	5.7%	2
c) Somewhat uncertain and unstable	**42.9%**	15
d) Highly uncertain and unstable	**42.9%**	15
e) Don't know	5.7%	2
	answered question	**35**
	skipped question	**7**

12. The current availability of credits compared to the anticipated need of our facility for load reductions is:

	Response Percent	Response Count
a) Sufficient	20.0%	7
b) Less than sufficient	34.3%	12
c) Don't know	**45.7%**	16
answered question		**35**
skipped question		**7**

13. How well established do you perceive the nutrient trading program to be?

	Response Percent	Response Count
a) Very well established	2.9%	1
b) Somewhat well established	11.4%	4
c) Somewhat incomplete	25.7%	9
d) Incomplete with unproven success	**57.1%**	20
e) Don't know	2.9%	1
answered question		**35**
skipped question		**7**

14. Information about costs and availability of credits is well documented.		
	Response Percent	**Response Count**
a) Agree	8.6%	3
b) Disagree	**77.1%**	27
c) Don’t know	14.3%	5
	answered question	**35**
	skipped question	**7**

15. Credit purchase is a stop-gap measure, and not a sustainable long-term investment.		
	Response Percent	**Response Count**
a) Agree	**85.7%**	30
b) Disagree	2.9%	1
c) Don’t know	11.4%	4
	answered question	**35**
	skipped question	**7**

16. Future total maximum daily load (TMDL) limits may make credit purchases obsolete.			
		Response Percent	**Response Count**
a) Agree		**65.7%**	23
b) Disagree		11.4%	4
c) Don’t know		22.9%	8
	answered question		**35**
	skipped question		**7**

17. The number of credits available in future years is undefined, resulting in a risk of future non-compliance.			
		Response Percent	**Response Count**
a) Agree		**91.4%**	32
b) Disagree		0.0%	0
c) Don’t know		8.6%	3
	answered question		**35**
	skipped question		**7**

18. Investment in nutrient credits might make sense if future technologies promise a decrease in the cost of plant improvements.			
		Response Percent	Response Count
a) Agree		**62.9%**	22
b) Disagree		17.1%	6
c) Don't know		20.0%	7
		answered question	**35**
		skipped question	**7**

19. Does it matter to you how credits you purchase are generated?			
		Response Percent	Response Count
a) Yes		38.9%	14
b) No		**50.0%**	18
c) Don't know		11.1%	4
		answered question	**36**
		skipped question	**6**

20. Which of the following methods of generating credits would you prefer?		
	Response Percent	**Response Count**
a) Transport of nutrients out of the watershed, such as manure export	3.0%	1
b) Reduction of use or release of nutrients into the watershed	**57.6%**	19
c) Don’t care	39.4%	13
	answered question	**33**
	skipped question	**9**

21. What would be your preferred method for acquiring credits?		
	Response Percent	**Response Count**
a) Deal privately, one-on-one with a farmer or other municipality	23.5%	8
b) Have a central “bank” to go to for acquiring credits	**61.8%**	21
c) Purchase from broker	0.0%	0
d) Other	5.9%	2
e) Don't care	8.8%	3
	answered question	**34**
	skipped question	**8**

22. Evaluate this statement: the complexity of the PANTP is an obstacle to our participation in the program

	Response Percent	Response Count
a) Strongly agree	11.8%	4
b) Agree	**50.0%**	17
c) Disagree	20.6%	7
d) Strongly disagree	0.0%	0
e) Don't know	17.6%	6
	answered question	**34**
	skipped question	**8**

23. Do you agree with the following statement? Purchase of credits is not necessary because nutrient effluent reduction modifications are planned to coincide with other necessary plant upgrades already scheduled.

	Response Percent	Response Count
a) Strongly agree	17.6%	6
b) Agree	29.4%	10
c) Disagree	**32.4%**	11
d) Strongly disagree	2.9%	1
e) Don't know	17.6%	6
	answered question	**34**
	skipped question	**8**

24. It is valuable to have the option of buying credits in the PANTP, whether or not those purchases finally get made.			
		Response Percent	**Response Count**
a) Strongly agree		17.6%	6
b) Agree		**52.9%**	18
c) Disagree		8.8%	3
d) Strongly disagree		2.9%	1
e) Don't know		17.6%	6
		answered question	**34**
		skipped question	**8**

25. We have used the DEP's NutrientNet website to view credits currently available to trade.			
		Response Percent	**Response Count**
a) Yes		38.2%	13
b) No		**58.8%**	20
c) Don't know		2.9%	1
		answered question	**34**
		skipped question	**8**

26. Please provide your contact information. This information will not be sold, traded, or leased.			
		Response Percent	**Response Count**
Name:		**100.0%**	32
Company:		**100.0%**	32
Email Address:		96.9%	31
Phone Number:		**100.0%**	

APPENDIX F

Point Source Survey List of Responders, Interviews, and Interview Summaries

Appendix F - Point Source Survey List of Responders, Interviews, and Interview Summaries

The following entities participated in the Material Matters online survey between 8/26/2008 to 9/18/2008.

1. Derry Township Municipal Authority
2. Lackawanna River Basin Sewer Authority
3. Mount Carmel Municipal Authority
4. Millersburg Borough Authority
5. Columbia Municipal Authority
6. Towanda Municipal Authority
7. Stiffler, McGraw & Associates, Inc.
8. Swatara Township Authority
9. City of Lebanon Authority WWTP
10. Elizabethtown Borough
11. Annville Township Authority
12. Clearfield Municipal Authority
13. Dover Township Sewer Authority
14. West Hanover Township Water and Sewer Authority
15. CET Engineering Services
16. Stiffler, McGraw & Associates, Inc for FTWSA
17. Northern Lancaster County Authority
18. Tri-Boro Municipal Authority
19. Buchart Horn, Inc.
20. Upper Allen Township WWTP

21. Danville Borough
22. Borough of Shippensburg Wastewater Treatment Facility
23. Lower Allen Township Authority
24. Ephrata Borough
25. Quad Three Group, Inc.
26. Mechanicsburg Wastewater Treatment Plant
27. Eastern Snyder County Regional Authority
28. Bloomsburg Municipal Authority
29. Lancaster Area Sewer Authority

[13 additional respondents declined to leave a contact name]

List of telephone interviewees:

- Carl Renquist, Borough of Chambersburg, Franklin County – Phase One Discharger
- William Drasher, Lewisburg Area Joint Sewer Authority, Union County – Phase One Discharger
- Joe Stuby, Freedom Township Water & Sewer Authority, Blair County – Phase 2/3 Discharger
- Robert Kissinger, South Middleton Township Municipal Authority, Cumberland County – Phase 2/3 Discharger

Interview Questions:

1. What are some of the factors you would have consider when thinking about participation in the Pennsylvania Nutrient Trading Program?
2. If you are not considering nutrient trades, what are some of the barriers or obstacles that keep you from doing so?
3. Do you anticipate participating in nutrient trades in the future?
4. Is uncertainty about future TMDL obligations an obstacle to nutrient trading for you?
5. Is uncertainty about future availability and cost of credits an obstacle for you?

Telephone Interview One

- Premise: out of the Chesapeake, reliability is the worst fear (might not last that long), it's not real well proven, construction (it's what we know to control our own destiny), we have a better chance of controlling our own destiny for construction; availability, cost volatility, uncertainty, fear of the unknown;
- Bank would be a good idea. Look at the whole picture, not just the short term.
- Regardless of what deal they may make with trading, they will probably still fall back on construction.
- O&M costs not considered. Power could be $42,000 a month on electricity
- TMDL obligations adds uncertainty, but makes a good reason for nutrient trades
- They are in the Potomac Watershed. Almost no credits available in the Potomac Watershed.
- Put the money on the farms, not on the point sources.If money is available for the farmers, it is a viable alternative. Don't bring the municipalities into it. Make grant money available to the `farmers. Hit it where happens. New limits are too stringent for treatment plants.
- The closer you get to the Bay, the more stringent the requirements should be.

Telephone Interview Two

- Dismayed by annual per-year trade.
- Views trading to be risky. An authority should not invest in anything except a rated investment. Should not "play" with the money of the municipality.
- They have never resolved the bidding aspect.
- Does not think trading is in the best interest of the Bay. It is a numbers game. PADEP has tried to push this to the aftermarket. Only one primary source: Red Barn.
- Problem from an environmental perspective: to load his creek with nutrients and buy his way out of having to clean up. The board members are not too keen on it either. If trading is cheaper you have to present it to the board, but he would be reluctant.
- They are studying plant upgrade now. The big guys have permits and schedules, we don't get them. All the small communities have not qualified. He has spoken to far more people not interested in trades, than to people going to trade. They did not get a permit yet, and don't have the mandate to reduce their nutrients. That gives them a disadvantage in grant applications. Not fair for the little guys. After the big guys reduce their nutrients further reductions might not be necessary.
- Barriers are instability of cost. Annual trades, but he has 20-year horizon.
- Uncertainty about TMDL obligation and about future availability and cost of credits

Telephone Interview Three

- We have discussed nutrient trading
- Depends on the cost, but not promising. They used estimates of $4 and $9 per pound of nitrogen and neither one worked for them
- Price volatility is second to cost
- Hasn't considered the stability of the program or other considerations because cost and price volatility were absolute barriers to participation in the program

Telephone Interview Four

- Won't participate in the program. He doesn't like the idea of it and doesn't think it will clean up the Bay. The program is a money-making opportunity for people such as brokers.
- He is in the planning stage for an upgrade: they have two reasons 1) the Bay, and 2) they have a hydraulic issue.
- He doesn't think the program will work to reduce nutrient loads.
- They could participate in the future. Their engineers are thinking about it
- TMDLs are not an obstacle for their participation in the program.
- Uncertainty about future availability and cost of credits is a concern

APPENDIX G

Supporting Data for Estimating Non-Point Source Nutrient Credit Generation

Appendix G - Supporting Data for Estimating Non-Point Source Nutrient Credit Generation

Table G-1 List of Counties and Their Estimated Acreage Falling within the Susquehanna Watershed Showing Simplified Delivery and EOS Ratios Used in the Current Study

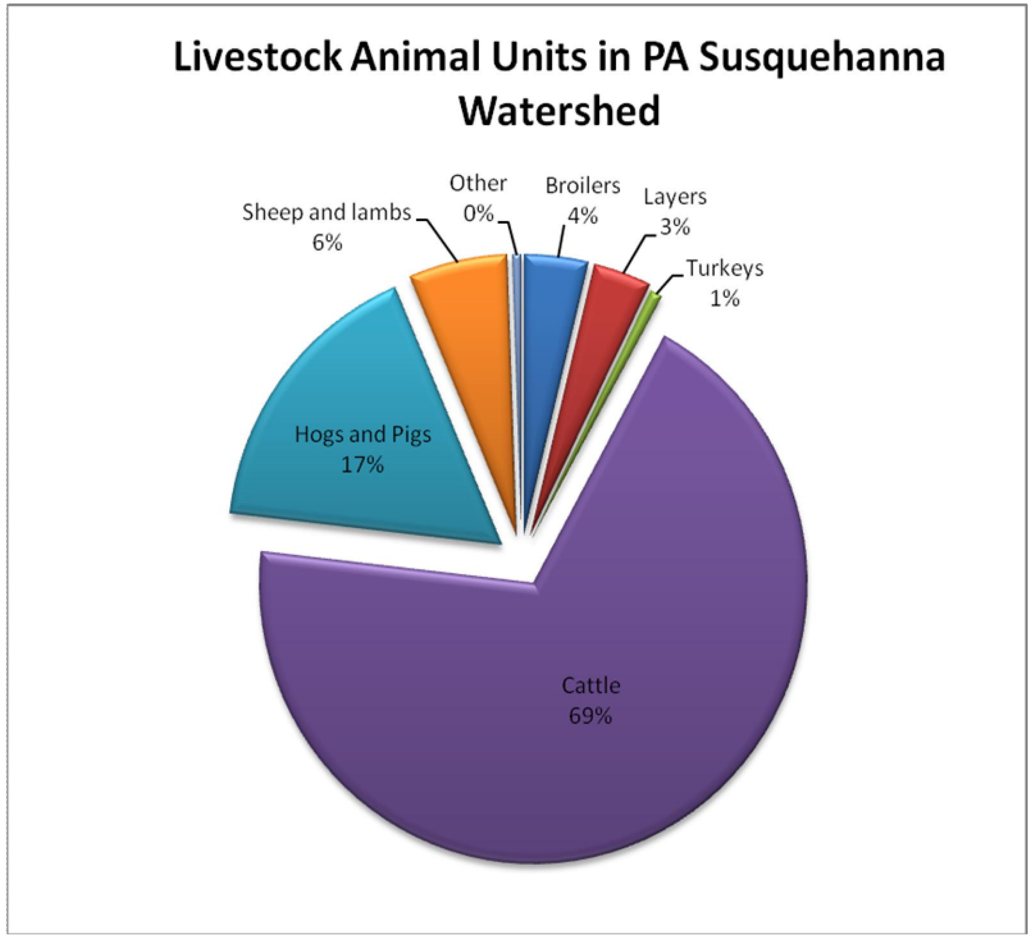
County	Farm Acres in watershed	Dominant Segment #	N EOS ratio	P EOS ratio	N Delivery Ratio	P Delivery Ratio
Adams	181,081	110	0.31	0.09	0.961	0.436
Bedford	192,811	90	0.45	0.11	0.897	0.436
Berks	10,784	110	0.31	0.09	0.961	0.436
Blair	85,687	100	0.35	0.08	0.880	0.436
Bradford	302,475	30	0.43	0.11	0.733	0.436
Cambria	35,199	50	0.50	0.15	0.836	0.436
Cameron	4,254	60	0.55	0.11	0.930	0.436
Carbon	9,629	40	0.42	0.12	0.871	0.436
Centre	165,234	60	0.55	0.11	0.930	0.436
Chester	16,817	800	0.48	0.15	1.000	1.000
Clearfield	36,577	50	0.50	0.15	0.836	0.436
Clinton	53,166	60	0.55	0.11	0.930	0.436
Columbia	123,514	40	0.42	0.12	0.871	0.436
Cumberland	143,159	80	0.32	0.12	0.951	0.436
Dauphin	94,983	80	0.32	0.12	0.951	0.436
Elk	11,084	60	0.55	0.11	0.930	0.436
Franklin	244,751	730	0.23	0.15	0.683	0.670
Fulton	100,575	740	0.21	0.12	0.749	0.670
Huntingdon	143,048	100	0.35	0.08	0.880	0.436
Indiana	4,719	50	0.50	0.15	0.836	0.436
Juniata	86,203	100	0.35	0.08	0.880	0.436
Lackawanna	31,284	30	0.43	0.11	0.733	0.436

(continued). List of Counties with Farm Acres in the Susquehanna Watershed showing Simplified Delivery and EOS Ratios used in the current study

County	Farm Acres in watershed	Dominant Segment #	N EOS ratio	P EOS ratio	N Delivery Ratio	P Delivery Ratio
Lancaster	411,848	720	0.27	0.06	0.891	0.436
Lebanon	106,306	110	0.31	0.09	0.961	0.436
Luzerne	36,608	40	0.42	0.12	0.871	0.436
Lycoming	177,347	60	0.55	0.11	0.930	0.436
Mifflin	90,486	100	0.35	0.08	0.880	0.436
Montour	39,964	70	0.45	0.27	0.941	0.436
Northumberland	119,129	40	0.42	0.12	0.871	0.436
Perry	129,092	80	0.32	0.12	0.951	0.436
Potter	47,198	60	0.55	0.11	0.930	0.436
Schuylkill	22,189	110	0.31	0.09	0.880	0.436
Snyder	100,034	80	0.32	0.12	0.951	0.436
Somerset	11,166	160	0.33	0.32	0.583	0.670
Sullivan	31,096	70	0.45	0.27	0.941	0.436
Susquehanna	189,287	30	0.43	0.11	0.733	0.436
Tioga	200,041	10	0.36	0.10	0.474	0.436
Union	69,424	70	0.45	0.27	0.941	0.436
Wayne	5,658	20	0.38	0.13	0.495	0.436
Wyoming	61,846	30	0.43	0.11	0.733	0.436
York	285,336	110	0.31	0.09	0.961	0.436

Figure G-1. Livestock animal units in PA Susquehanna Watershed. Data processd from USDA Agricultural Census Data, 2002 (USDA, 2005).

	Animal Equivalent Units*
Broilers	63,946
Layers	58,530
Turkeys	12,291
Cattle	1,171,319
Hogs and Pigs	285,723
Sheep and lambs	99,478
Other	9,340



*An animal equivalent unit is equal to 1,000 lbs of live weight of livestock.

Figure G-2. Manure Nitrogen Production in PA Susquehanna Watershed. Data processd from USDA Agricultural Census Data, 2002 (USDA, 2005).

	Manure (tons/yr)
Broilers	245,072
Layers	277,725
Turkeys	26,917
Cattle	17,742,549
Hogs and Pigs	9,749,803
Sheep and lambs	726,186
Other	76,705

	Manure N (tons/yr)
Broilers	8,945
Layers	5,138
Turkeys	982
Cattle	70,970
Hogs and Pigs	28,679
Sheep and lambs	8,351
Other	460

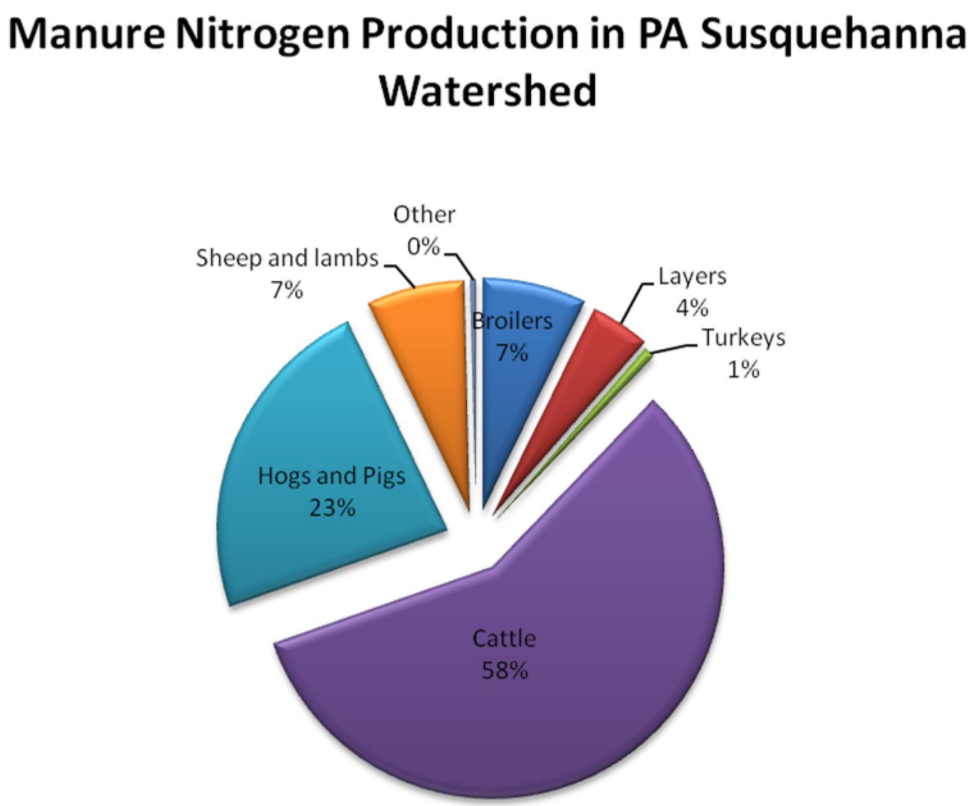


Figure G-3. Manure Phosphorus Production in PA Susquehanna Watershed. Data processd from USDA Agricultural Census Data, 2002 (USDA, 2005).

	Manure P tons/yr
Broilers	2,635
Layers	3,284
Turkeys	509
Cattle	9,537
Hogs and Pigs	13,565
Sheep and lambs	1,249
Other	82

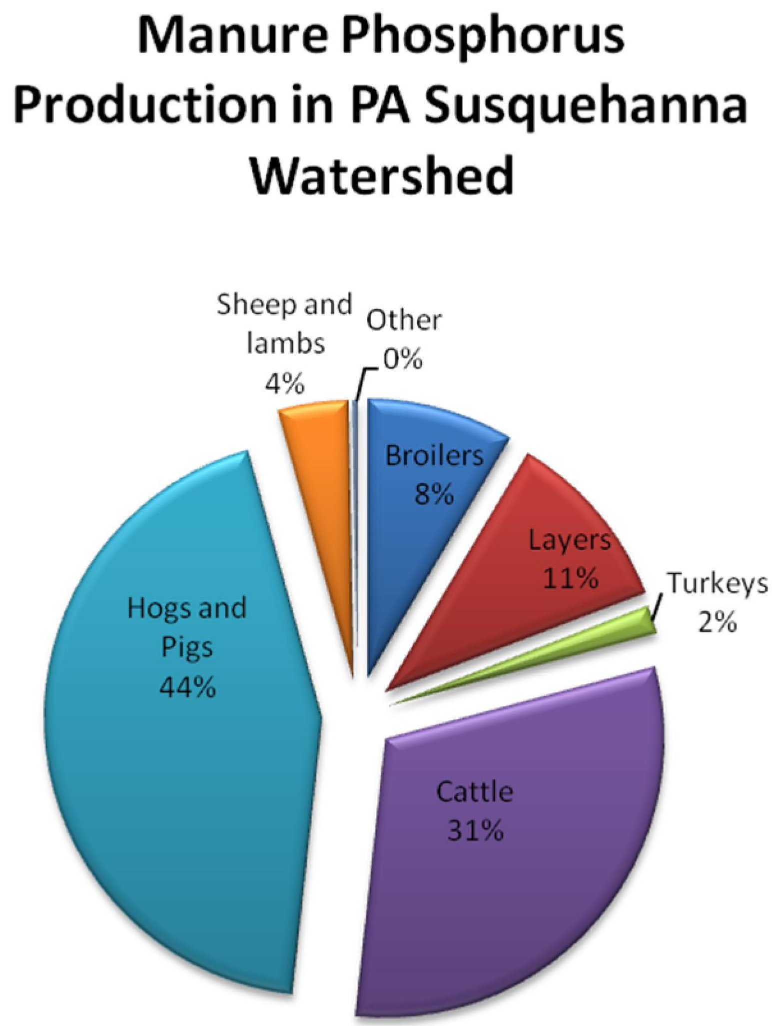


Figure G-4. Farm Acreage Distribution in PA Susquehanna Watershed. Data processd from USDA Agricultural Census Data, 2002 (USDA, 2005).

Land Use	Acres
Forage and Hay	1,057,379
Corn (grain)	449,029
Corn (silage)	368,642
Soybeans	235,909
Wheat	103,580
Oats	20,111
apples	14,225
Other	9,354

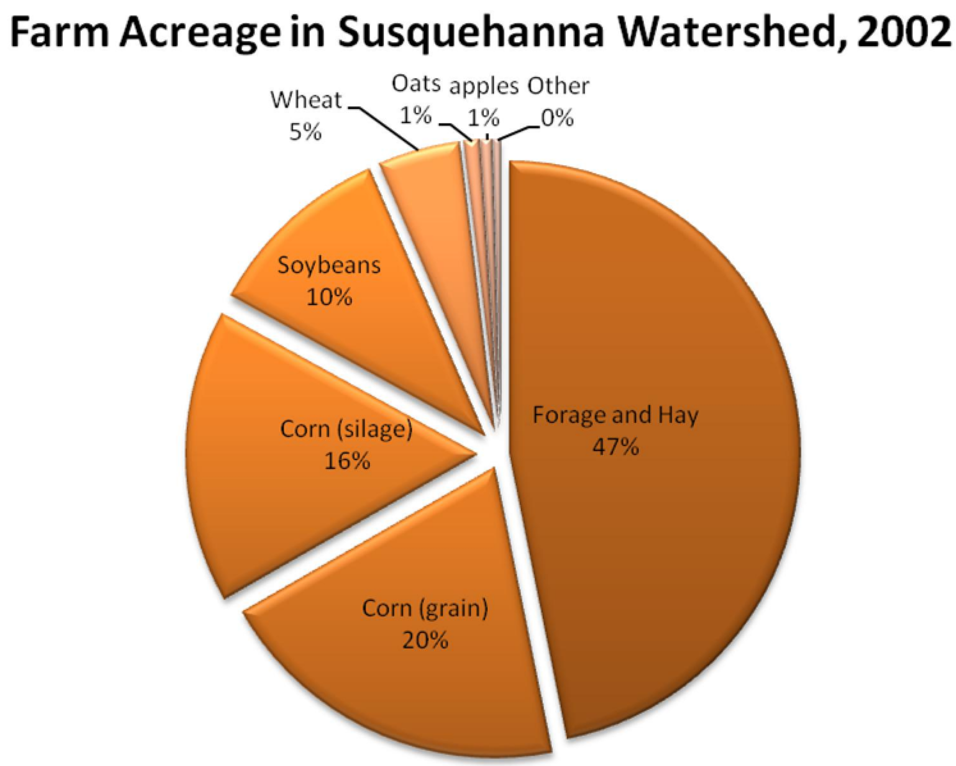


Figure G-5. Fertility Balance for nitrogen in PA Susquehanna Watershed. Sources: USDA Agricultural Census, 2002 (USDA, 2005) for farm acreage and livestock; crop need and manure production – Penn State Agronomy Guide, 2007-2008; fertilizer use for PA - http://www.ers.usda.gov/Data/FertilizerUse/, (Wen Huang, 2007).

	Estimated N crop need	Manure N produced	Fertilizer N used	Fertilizer + Manure N
Thousand Tons	140	124	43	166

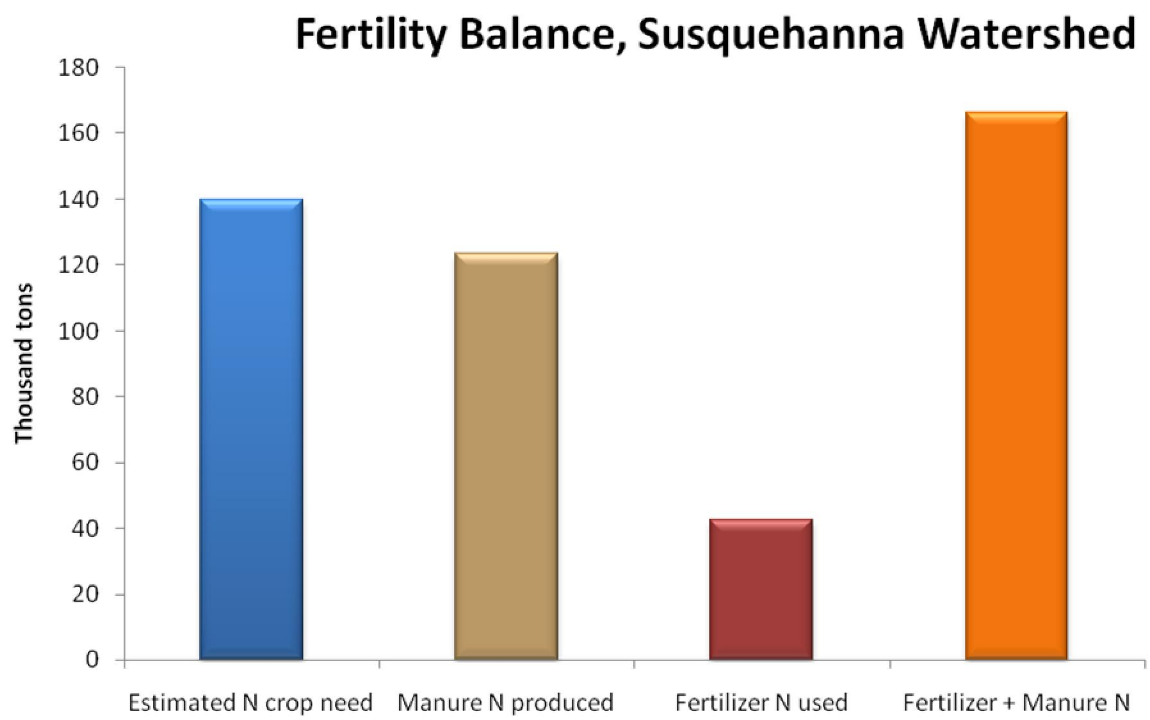


Figure G-6. Yearly production of N and P in PA Susquehanna Watershed from Different Sources.

	Thousand Tons/yr
Manure N	123.53
Fertilizer N application to farmland	95.60
Manure P	30.86
Fertilizer P application to farmland	37.04

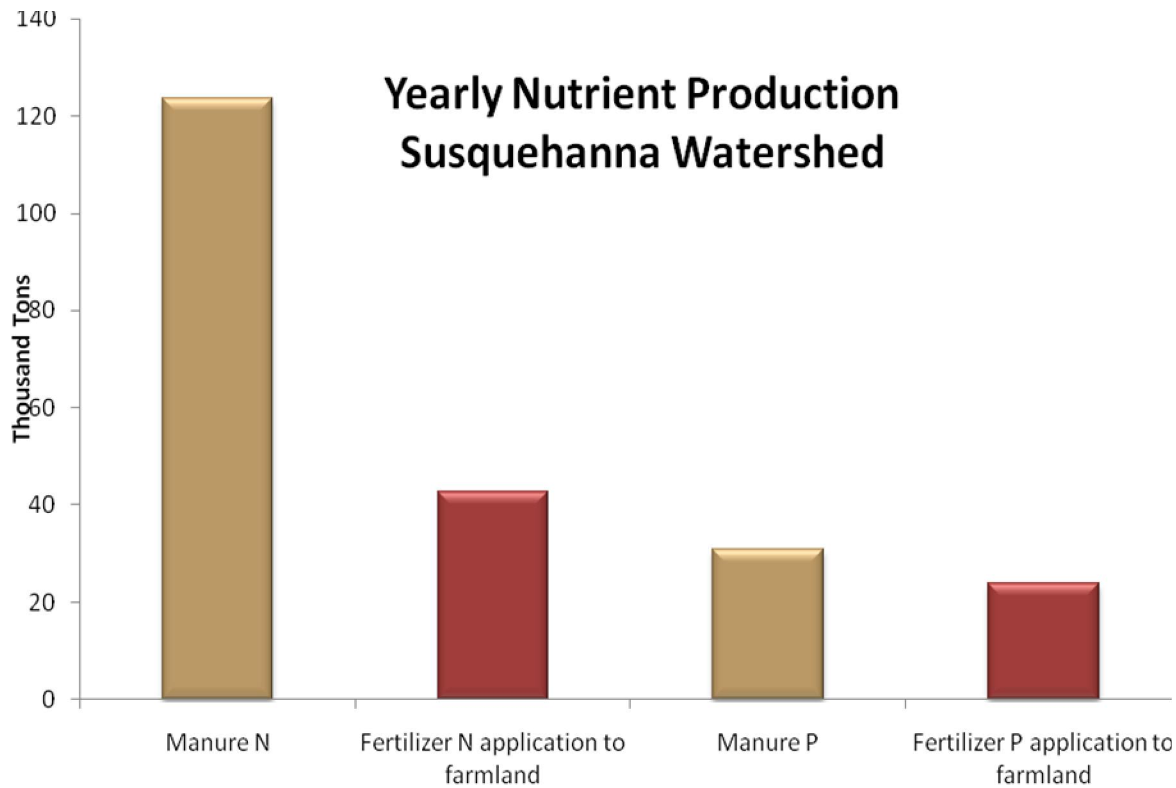


Table G-2 Manure Export Methodology used in Red Barn Proposal for Client 0136, April 5, 2007 (PADEP, 2007) This methodology was used to generate the manure export potential credits in the current study.

Data Type	Formula
A. Animal type	
B. Animal number	
C. Average weight	
D. Time on farm (days)	
E. Animal Equivalent Units (AEU)	
F. Total animal Equivalent Units	
G. Manure production rate (lbs/AEU/Day)	
H. Total manure production (tots/yr)	(F)*(G)*(365 days/yr)/(2000 lbs/ton)
J. Manure utilized on farm (tons/yr)	
K. Manure exported off farm (tons/yr)	
L. Total nitrogen in manure (lbs/ton)	
M. Total phosphorus in manure (lbs/ton)	
N. Nitrogen applied on importing (lbs/yr)	(K)*(L)
P. Nitrogen available for crop (lbs)	15%
Q. Nitrogen lost to the environment (lbs)	85%
R. Watershed delivery ration, N	[varies by county]
S. Edge of segment ratio, N	[varies by county]
T. Nitrogen reaching Bay (lbs/yr)	(Q)*(R)*(S)
U. Phosphorus reaching Bay (lbs/yr)	(AA)/8
Proposed utilization assumption: replace manure with commercial fertilizer on importing farms.	
V. Nitrogen applied on importing farms (lbs)	(P)*2
W. Nitrogen available for crop (lbs)	50%
X. Nitrogen lost to the environment	50%
Y. Watershed delivery ratio, N	[varies by county]
Z. Edge of segment ratio, N	[varies by county]
AA. Nitrogen reaching Bay (lbs/yr)	(X)*(Y)*(Z)
AB. Phosphorus reaching Bay (lbs/yr)	(AA)/8
AC. Reduction in Nitrogen reaching Bay (lbs/yr)	(T)-(AA)
AE. Reduction in Phosphorus reaching Bay (lbs/yr)	(U)-(AB)

References

Chesapeake Bay Program. 2008. Chesapeake Bay Phase 5 Community Watershed Model. Available at http://www.chesapeakebay.net/phase5.htm

Pennsylvania Department of Environmental Protection Water Planning Office. 2007. Red Barn Nutrient Trading Proposal for Client 0136. [Public Document Available Upon from PADEP upon Request]

U.S.D.A. National Agricultural Statistics Service. 2005. *2002 Census of Agriculture*. (Geographic Area Series 1C). Government Printing Office, Washington, DC. available at http://www.nass.usda.gov/Census_of_Agriculture/index.asp.

Wen Huang. 2007. USDA Economic Research Service. U.S. Fertilzer Use and Price. [Data Set]. Available at http://www.ers.usda.gov/Data/FertilizerUse/

APPENDIX H

Nutrient Trading Assessment Interviews

Appendix H

Nutrient Trading Assessment – List of Persons Interviewed

The following persons were interviewed as part of an assessment of the Pennsylvania Nutrient Trading Program (PANTP).

Profession	Name	Association
Municipal	Jodie Reese	CET Engineers
	John Brosious	Pennsylvania Municipal Authority Association
Academia	James Shortle, Ph.D.	Pennsylvania State University
	Robin Brandt, Ph.D.	Pennsylvania State University
Chesapeake Bay	Kenn Pattison	PA Department of Environmental Protection
Program Technical Consultants	Barry Evans	Penn State Institutes of Energy and the Environment
Home Builders	Robert Fisher, P.L.S., P.E.	R.J. Fisher & Associates
	Grant Gulibon	Pennsylvania Home Builders Association
Aggregators	Peter Hughes	Red Barn Trading Company
	David Mager	Bion Environmental Technologies, Inc.
	Jeremy Rowland	Bion Environmental Technologies, Inc.
Soil Conservation Districts	Don McNutt	Lancaster County Conservation District
	Kevin Seibert	Lancaster County Conservation District

Verifiers	Donald Robinson	Former Lancaster County Conservation District Director
Regulators	Ann Smith	PADEP
	Frank Schneider	PADEP

List of Survey Questions and Notes from Interviews

The survey questions in this document were presented to a number of different respondents in telephone or in-person interviews. Experts from various backgrounds were interviewed to give their opinions and thoughts about the Pennsylvania Nutrient Trading Program (PANTP).

Survey Questions for Selected Experts

Interview with Prof. Jim Shortle, PSU

1. Nutrient trading should work, and it looks very good in theory, yet very few trades have happened in trading programs. This is especially true in the Pennsylvania's Nutrient Trading Program (PANTP). Why have so few credits been generated?
2. Do you see the number of trades as an indicator of program effectiveness? Some people don't. If the nutrient load is reduced and people have the option to trade (even if they ultimately choose not to), perhaps these programs work even if there are only a few trades. What do you think?
3. What obstacles do you see that prevent the development of willing sellers and willing buyers in the PANTP?
4. What policy options, if any, are available to remove these obstacles?
5. Supply-side limitations that we have observed in the PANTP include:
    - Inability to eliminate or absorb risk
    - Inability to ensure long-term supply or stability of supply
    - Inability to structure costs so that they are attractive to the demand-side
    - Inability to compete with low-risk, high-cost options of plant upgrades
    - Inability to mitigate risks associated with future total maximum daily load (TMDL) obligations

   What comments do you have? Do you have any additions to the list? Do you have any ideas about how to mitigate these problems?
6. Demand-side limitations in PANTP seem to include:
    - Extreme risk aversion of point sources

- Structures of decision making that promote construction
    i. Engineers who design plant improvements also are charged with making decisions about whether such improvements are preferable over nutrient trades. They may experience conflict of interest when they give advice that would obviate their design efforts and billable work load.
    ii. Information about trading is often supplied to point sources from their engineering contractors.
- Nutrient load limits go into effect in 2010. Unless the long-term stability of supply problem is resolved plants have no incentive to buy ahead of time (except possibly to secure low prices, but since prices have not yet been convincingly established …).

Do you have any comments?

7. State Senate Bill 1493 was introduced recently; there will be a hearing on September 17th. The bill proposes the creation of a board with the power to sell nutrient credits, generate revenues, and (I think) assume risk. The board will be a governmental entity and will generate revenues sufficient to offset its cost of operations. The board will hold credits in reserve and it shall have a technical subcommittee to provide assistance.
    - Do you think that such an entity can successfully manage risk?
    - What are some of the pluses and minuses of such a structural shift?
8. If there are some limitations to DEP's potential effectiveness in a "banking" role, what alternatives can you imagine or recommend?
9. How can the PANTP be improved?
10. Some of the trades in the watershed have been manure export trades. The nutrients literally get trucked out of the watershed. Is this a good idea? Is manure export "cheating"?
11. Do you think the PANTP will ultimately be effective as a trading mechanism?

Interview with Don McNutt, Lancaster County Conservation District

1. Tell us about the trades you were involved in?
2. Why do you think there have not been a lot of trades yet? Is there a problem with demand?
3. Lancaster and Cumberland Districts received a grant for local trading projects initiatives. Do you think the credits generated from this grant could have been generated without the grant?
4. What BMPs do you think are the best for reducing nutrient load to the watershed?
5. Do the calculation methodologies employed by DEP capture this effectiveness?
6. Why do you think that so few credits have been generated from BMPs compared to manure export?
7. What comments have you heard from others about how the program is working?

8. Do you think the program is successful?
9. What improvements to the PA Nutrient Trading Program would you like to see, if any?
10. Do you have any opinions on Senate Bill 1493 that would create a board able to buy and sell credits?

Interview with Jodi Reese, CET, Inc

For this interview we used the same survey questions that were used in the online survey for PS dischargers and asked Jodi how her clients would be likely to answer the questions and how she would advise them about the issues raised in the survey.

Interview Agenda with Barry Evans, PSU

1. How well do you expect that the PANTP will perform and how well is it performing now?
2. What are your opinions, if any about the PANTP?
3. What do you think of manure export as a viable way of reducing nutrient loads to the Bay?
4. Are transaction costs associated with generating credits on farms likely to be less than funds received for credits generated?

Interview with Ken Pattison, PADEP

1. How do you envision the role of the PA Nutrient Trading Program in creating reductions of N and P to the Chesapeake Watershed? What would be the big picture of how the program should work? Which of the following practices should play a bigger role than others?
    - Manure export
    - BMP practices to sequester nutrients and keep them on farmland
    - Lower application of manures or chemical fertilizers
    - Reduction of nutrient imports into the watershed (animal feed and commercial fertilizers)
    - Recycling of nutrients from waste streams back to farmland
    - Better wastewater treatment of CAFOs
2. Agriculture is responsible for ~50% of the N and P in the Bay, according to the PADEP Bay Strategy documents. What do you think are the major tasks that agriculture has to undertake to reduce its contribution to the problem?
3. In your estimation, has the PA Nutrient Trading Program lived up to expectations in terms of number of successful trades, public involvement, and measureable outcome in the Bay?
4. Why or why not?

5. What comments from others have you received about program effectiveness?
6. Non-point sources of nutrients to the Bay can generate credits by:
   - changing practices and adopting BMPs,
   - making changes in manure practices, or
   - making changes in commercial fertilizer application rate.
7. By far, the ways to generate the most credits involve manure practices. Why was such a strong emphasis on manure adopted in the credit generation scheme?
8. Land-uses that currently do not involve application of fertilizers, such as CREP land, are not able to generate credits. Also, soybean acreage cannot generate credits. What was the reasoning behind the decision to exclude these land practices from credit generation?
9. What other nutrient trading programs similar to PA's have been successful? Can you compare and contrast them to PA's program?
10. Very few non-point to point source trades have happened in the watershed so far. Why do you think this is the case?
11. Nearly all of the non-point source credits are from manure practices rather than from BMPs. The credits generated from BMP that have been generated so far have been supported by grant funding for Conservation Districts to aggregate credits. Do you think BMPs at a smaller farm scale with no grant funding are likely to participate in the program?

Interview with Peter Hughes of Red Barn Trading Company

Manure

1. Why did you choose to focus on manure for your trading strategy?
2. Manure export has been a successful strategy for your company to generate credits. Why do you think it has worked so well?

BMPs

3. Did you consider trying to work with BMPs to generate non-point credits? Why or why not?
4. Do you think that BMPs are a viable option for credit generation?
5. Why have there been so few trades from BMPs in comparison to the number of trades from manure export?

Number of trades between point and nonpoint sources

6. There are more credits posted than have been purchased. Why do you think that is the case? Do you think the supply is higher than the demand?
7. Why do you think that there have been so few trades between point and non-point sources in the watershed?

8. What are the barriers to successful trading?
9. What type of information would a municipal discharger need to consider for participation in the nutrient trading program?

Improvements to the program

10. How do you think the PA nutrient trading program could be improved?

Comments about the program

11. What kinds of comments and opinions have you heard about the program from clients, regulators, the public, etc?
12. Is there a general consensus, or are the comments all over the map?

How did some of your trades happen?

13. Fairview Township: What made them decide to make a 15 year agreement with Red Barn?
    a. What were some of the concerns that Fairview had and how were those concerns resolved?
    b. What were some of the factors for the decision?

Program status

14. How much more flux do you expect the program to undergo?
15. How stable is the program, in your opinion?
16. How much inertia does the program have?
    a. Is it like a train that can't get off its track and go a different way?
    b. Is it in flux?
    c. Are changes to the program possible?

Opinions about the success of the program

17. Do you think the program is working or is it not working?
18. How well do you think the different entities involved in the program are doing their jobs?
    a. DEP
    b. Conservation Districts
    c. Others

Structure of the program

19. How do you feel about the calculation methodologies DEP uses for credit generation?
20. Do you think the structure of the decision-making process for credit generation could be improved? How?

Credit failure

21. What strategies do you use to counteract concerns about credit failure?
    a. That is, if an entity buys credits and they fail to be generated, how is responsibility allocated or reallocated?
    b. What strategies do you see as necessary in the case of credit failure?

<u>Monitoring</u>

22. Who is responsible for monitoring whether credits sold are actually produced?
23. What role does your company have in monitoring?

<u>Other Programs</u>

24. What information do you have about other nutrient trading programs around the country and their success or lack of success?
25. What do you think PA could learn from their example?

Interview with BION's David Mager and Jeremy Rowland

1. What is BION's approach to solving the Chesapeake Bay nutrient problem?

2. There have been a number of trades in the program with manure management used to generate credits, but very few having to do with landuse change. Why do you think this is so?

3. There are more credits generated than sold. Do you think there is a problem with demand?

4. What comments have you received about the nutrient trading program?

5. Do you think the program is successful? Will it be successful?

6. The program is structured to allow many different groups an opportunity to comment on proposals to generate credits. Has the review process been a burden for your company in terms of time and effort?

7. Have you reviewed PA Senate Bill 1493? Do you have any comments about the bill?

Interview with Ann Smith and Frank Schneider, PADEP

This interview consisted of technical questions about credit generation methodology for a farm seeking to generate nutrient trading credits from BMPs. Questions pertained to the specific example of the farm in question and were useful for gaining an understanding of PADEP's approved credit generation methodologies.

Interview with Robert Fisher and Grant Gulibon, Pennsylvania Builders Association

1. Help us understand the impact of the Chesapeake Bay Initiative on home builders in the bay watershed. How do the regulations/policies shape your members?

2. Describe structural issues and barriers for participating in the PANTP.

APPENDIX I

Certified Nutrient Credits From PADEP Registry on September 25, 2008

Appendix I - Certified Credits from PADEP Registry on September 25, 2008

Applicant and proposal description	Nitrogen Credits	Phosphorus Credits	Sediment Reductions	Source of Credits
1. HRG/Milton Regional Authority- Facility generated credits through the process/treatment of the wastewater. These credits may be revised once the facility receives its final NPDES permit.	46,000	6,000	0	Nutrient Reduction
2. Red Barn Trading Company- Poultry Manure Export from Snyder County to location outside of the watershed.	24,405	3,051	0	Manure Export
3. Red Barn Trading Company- Poultry Manure Export from Union County to location outside of the watershed.	10,525	1,317	0	Manure Export
4. Red Barn Trading Company- Poultry Manure Export from Snyder County to location outside of the watershed.	11,050	1,381	0	Manure Export
5. Red Barn Trading Company- Poultry Manure Export from Snyder County to location outside of the watershed.	15,621	1,953	0	Manure Export
6. Red Barn Trading Company- Poultry Manure Export from Schuylkill County to location outside of the watershed.	21,141	2,643	0	Manure Export
7. Red Barn Trading Company- Poultry Manure Export from Juniata County to location outside of the watershed.	8,246	1,031	0	Manure Export
8. Red Barn Trading Company- Poultry Manure Export from Huntington County to location outside of the watershed.	9,036	1,130	0	Manure Export

Applicant and proposal description	Nitrogen Credits	Phosphorus Credits	Sediment Reductions	Source of Credits
9. Red Barn Trading Company- Poultry Manure Export from Juniata County to outside watershed.	11,154	1,394	0	Manure Export
10. Red Barn Trading Company- Poultry Manure Export from Franklin County to location outside of the watershed.	68,122	8,515	0	Manure Export
11. Red Barn Trading Company- Poultry Manure Export from Juniata County to location outside of the watershed.	9,243	1,155	0	Manure Export
12. Red Barn Trading Company- Poultry Manure Export from Lancaster County to location outside of the watershed.	36,679	4,585	0	Manure Export
13. Red Barn Trading Company- Poultry Manure Export from Lancaster County to location outside of the watershed.	14,269	1,784	0	Manure Export
14. Red Barn Trading Company- Poultry Manure Export from Lebanon County to location outside of the watershed.	55,387	6,923	0	Manure Export
15. Red Barn Trading Company- Poultry Manure Export from York County to location outside of the watershed.	22,860	2,857	0	Manure Export
16. Red Barn Trading Company- Poultry Manure Export from Lancaster County to location outside of the watershed.	12,344	1,543	0	Manure Export
17. Red Barn Trading Company- Poultry Manure Export from Perry County to location outside of the watershed.	17,319	2,165	0	Manure Export
18. Red Barn Trading Company- Poultry Manure Export from Adams County to location outside of the	24,724	3,090	0	Manure Export

Applicant and proposal description	Nitrogen Credits	Phosphorus Credits	Sediment Reductions	Source of Credits
watershed.				
19. Red Barn Trading Company- Poultry Manure Export from Juniata County to location outside of the watershed.	6,671	834	0	Manure Export
Applicant and proposal description	**Nitrogen Credits**	**Phosphorus Credits**	**Sediment Reductions**	**Source of Credits**
20. Red Barn Trading Company- Poultry Manure Export from Lancaster County to location outside of the watershed.	7,054	882	0	Manure Export
21. Red Barn Trading Company- Poultry Manure Export from Lancaster County to location outside of the watershed.	7,699	962	0	Manure Export
22. Red Barn Trading Company- Poultry Manure Export from Lancaster County to location outside of the watershed.	15,624	1,953	0	Manure Export
23. Mount Joy Borough Authority- Continuous No-till on 930 acres.	11,718		0	Best Management Practices
24. Berks County Conservation District- Cover crops planted on ten tracts of land, credits were generated during the 2006-2007 water year.	1,851		0	Best Management Practices
25. Chesapeake Nutrient Management- Poultry manure export from Adams County to a location outside of the watershed, credits were generated during the 2006-2007 water year.	6,236	780	0	Manure Export
26. Lititz Run Watershed Association- Stream restoration project; credits are non-transferable.	1,381	68	129	Best Management

Applicant and proposal description	Nitrogen Credits	Phosphorus Credits	Sediment Reductions	Source of Credits
				Practices
27. Berks County Conservation District- Cover crops planted on forty-four tracts of land, credits were generated during the 2007-2008 water year.	7,834		0	Best Management Practices
28. Bion Environmental Technologies- use of a proprietary livestock waste treatment technology for a scrape dairy operation located in Lancaster County. This project can generate credits for multiple years.	175,109	21,889	0	Manure Treatment
29. Union County Conservation District- installation of field lane stabilization project on 7 farms. This project can generate credits for multiple years.	146	2	35,464	Best Management Practices
30. Lebanon County Conservation District- installed 2 mortality composters. This project can generate credits for multiple years.	4	2	0	Mortality composters
31. Dauphin County Conservation District- worked with 2 landowners to installed stream bank fencing, planted a riparian buffer and installed a mortality composter. These projects can generate credits for multiple years.	3,463	183	0	Best Management Practices
32. Chester County Conservation District- worked with 8 land owners to have cover crops, credits were generated during the 2006-2007 water year.	39,977		0	Best Management Practices
Total:	**702,892**	**80,072**	**35,593**	

APPENDIX J

Statistical Analysis by Pennsylvania State University Statistical Consulting Center

PENNSTATE

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October 16, 2008

Ralph Eschborn
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Re: Assessment for Statistical Services (SCC# 08-3-014). Cost of Compliance Analysis

Dear Ralph,

You were commissioned by the PA State legislative Budget and Finance Committee to conduct a cost analysis for municipal wastewater treatment facilities. You sent out surveys to 183 Chesapeake watershed municipal wastewater dischargers that were deemed significant by the PA Department of Environmental Protection. Of these, you have data for 67 respondents [that reported estimated or actual capital costs. The number of total respondents, including those not reporting capital costs, was greater][1].

All of the facilities that produce at least 10 million gallons per day (MGD) of discharge completed the survey (a complete enumeration). The cost estimates of these facilities can simply be summed in the computation of total cost of compliance. On the other hand, not all of the facilities that produce less than 10 MGD responded to the survey, and so the respondents from this group comprise a sample. You plan to use a predictive equation based on these sample data to provide estimates of the cost of compliance for the non-respondent facilities. These estimates can then be combined with the known cost for the larger facilities and the respondent small facilities to yield a total cost of compliance.

Methods:

A) Data Inspection
We compiled the data from excel spreadsheets to produce a single dataset that included the information from the original mailing list of 183 facilities and the information from the compilation of respondent data. Where a discrepancy existed between the flows (MGD) listed in the mailing list and the flow reported by respondents, we used the flow reported in the completed survey of the respondents. In this data exploration we verified that all 8 facilities with MGD > 10 (Large Facilities) did in fact report costs.

[1] [added by Metcalf & Eddy for clarification]

To evaluate the potential for sample bias, we compared the frequency of non-respondent Small Facilities by phase with the original mailing list by phase. We then used a Chi-Square test to evaluate the null hypothesis that the proportion of non-respondent small facilities in each phase of implementation did not differ from the proportion of all small facilities that appeared in the original mailing list.

B) Cost Determination for Respondent Facilities
For facilities that did respond to the survey, we summed the costs reported. This was done for the 8 Large Facilities, and then for the 59 Small Facilities that responded to the survey.

C) Cost estimation for Non-respondent Facilities
For the remaining 116 Small Facilities that did not respond to the survey we developed a prediction equation (based on the respondent data) to predict cost from the flow (MGD) listed in the original mailing list. Prior to developing this prediction equation, we used an Analysis of Covariance (ANCOVA) to be sure that the facilities that belonged to the various phases of implementation had similar relationships between cost and MGD. Once we determined that we could pool the facilities in the different phases, we developed a single prediction equation using simple linear regression. Substituting each facility MGD into the predictive equation yielded estimates of cost for each of the 116 non-respondent Small Facilities. These estimated costs were then summed to yield a total cost for the non-respondent Small Facilities.

<u>Results</u>

The numbers of facilities that belong to the various phases of implementation were compiled for the full mailing list and for the non-respondent data. If there is no sampling bias, we expect there to be no significant difference in the proportion of facilities by phase of implementation for non-respondents compared to the mailing list. The formal test of this is given by the 'p-value' for the Chi-square statistic (in bold-face below):

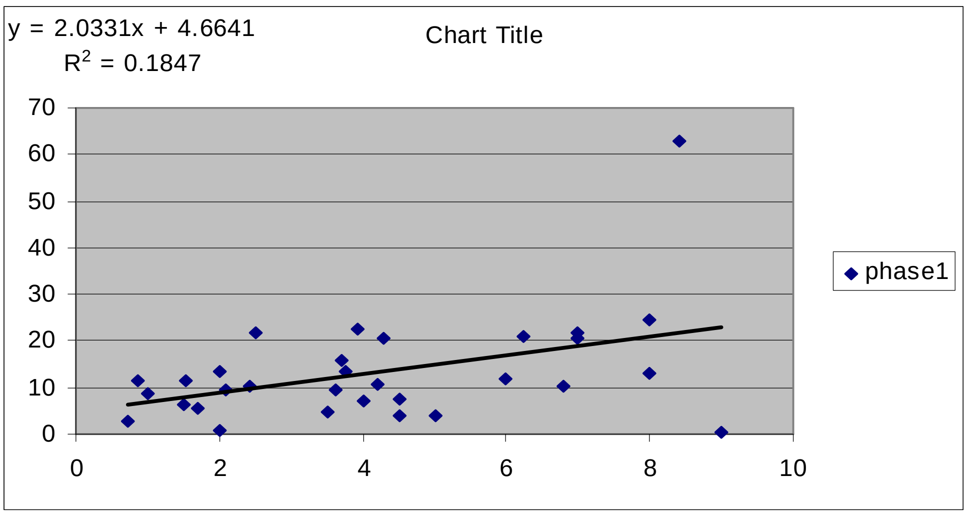
Non-respondent Small Facilities Profile Comparison

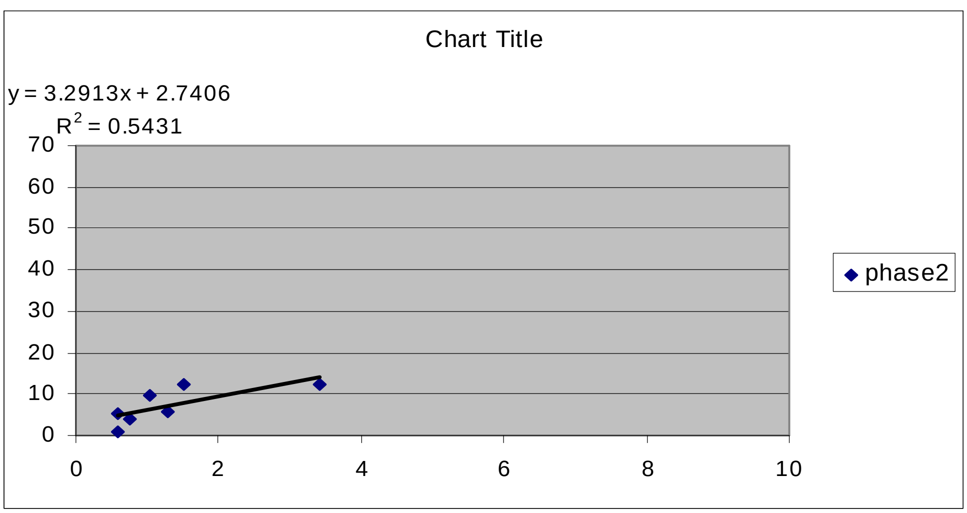
Table of phase by source

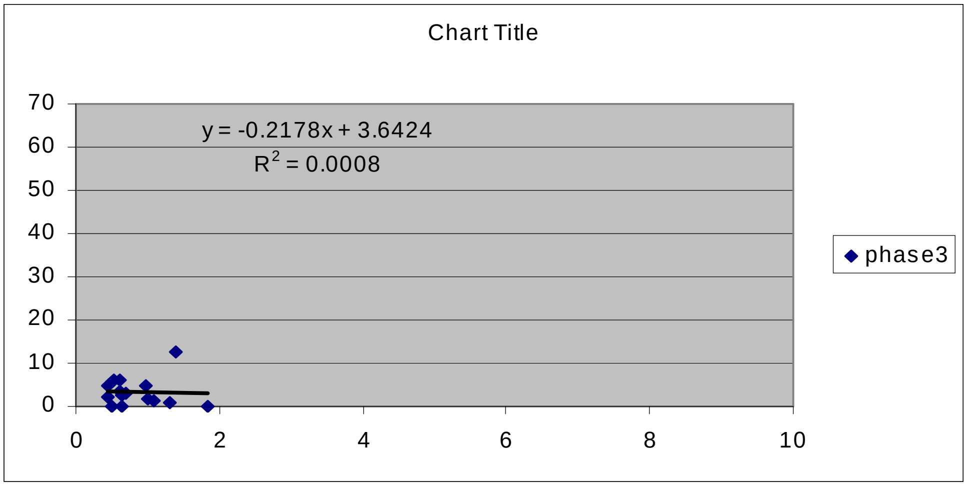
phase / source Frequency, Col Pct	mailing	nonresp
1	55 31.43	23 19.83
2	48 27.43	40 34.48
3	72 41.14	53 45.69
Total	175	116

Statistic	DF	Value	Prob
Chi-Square	2	4.9862	0.0827

We interpret the p-value as follows: We want to use a 95 % confidence level, and so if the p-value is less than 0.05, then we would reject the null hypothesis that there are no differences in the proportions of non-respondents by phase compared to the original mailing list. We see from this test (the p-value exceeds 0.05) that we would accept the null hypothesis and conclude that there is no significant difference in the proportion of facilities in each phase for non-respondent facilities compared to the original mailing list. As a result, inferences can be drawn about the population of facilities (the mailing list) from the respondent data without bias introduced by considering only the sample of responding facilities. The respondent data were then sub-divided by phase and separate regression analyses were considered for each of the phases. The plots of the data by phase appear below:





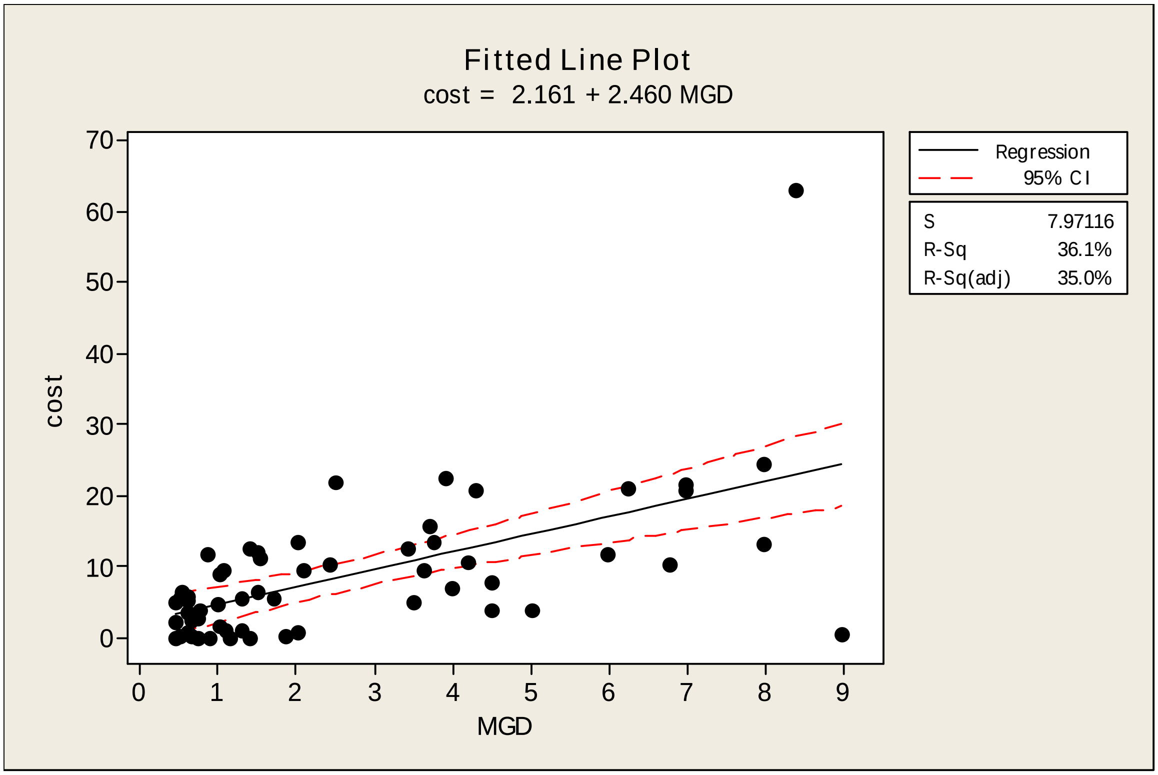


The trends in for the facilities in phase 1 and phase 2 were similar, but for phase 3 there was very little spread of datapoints, and no statistically significant regression was obtained. The analysis of covariance explicitly compares the regression results for these three phases and tests for significant differences among the slopes obtained.

```
Analysis of Covariance

The Mixed Procedure (SAS)

        Type 3 Tests of Fixed Effects

              Num     Den
Effect         DF      DF    F Value    Pr > F

phase           3      53       0.83    0.4820
MGD*phase       3      53       4.65    0.0058


                           Contrasts

                                Num     Den
Label                            DF      DF    F Value    Pr > F

slopes are equal hypothesis       2      53       0.22    0.8000
```

In this output we first test for the null hypothesis that all the slopes of the three regression lines are actually equal to 0. The p-value for this test is in the 'Type 3 Test for Fixed Effects' for the effect labeled 'MGD*phase' (in boldface). The fact that this p-value (0.0058) is less than 0.05, we conclude that the at least one of the regression slopes is significantly different from 0. Then looking at the second hypothesis test of the ANCOVA in the section labeled 'Contrasts', we test the null hypothesis that the slopes of the regressions for each phase are equal. Here we see that the p-value (0.8000) is larger than 0.05, and we conclude that the slopes of the individual regressions do not differ significantly. Therefore we can pool the data for the three phases together and fit a single regression line to obtain a single prediction equation to be used for all the non-respondent facilities.

A regression analysis was performed first by using all 59 non-respondent Small Facilities. The results of this regression appear in the figure below (from Minitab).



We can see that there are two values in the plot (at the two highest MGD values) that stand out away from the majority of data points. These two data points may have a 'leveraging' effect on the overall fit of the line, and therefore we performed an Influence Diagnostics test in SAS. A portion of the output is presented below:

```
                         SAS Output Statistics

                        Cook's           Hat Diag      Cov
Obs     -2-1 0 1 2          D   RStudent        H     Ratio    DFFITS-------DFBETAS-------

 47  |       |**     |   0.013    1.0148   0.0248    1.0244    0.1619     0.0219       0.0911
 48  |     **|       |   0.020   -1.2002   0.0270    1.0120   -0.1998    -0.0156      -0.1218
 49  |      *|       |   0.007   -0.7041   0.0270    1.0461   -0.1172    -0.0091      -0.0714
 50  |     **|       |   0.032   -1.3760   0.0334    1.0029   -0.2559     0.0115      -0.1796
 51  |      *|       |   0.012   -0.6583   0.0499    1.0738   -0.1509     0.0323      -0.1227
 52  |       |       |   0.006    0.4375   0.0550    1.0889    0.1056    -0.0260       0.0879
 53  |     **|       |   0.045   -1.1129   0.0676    1.0636   -0.2997     0.0923      -0.2594
 54  |       |       |   0.004    0.3037   0.0726    1.1135    0.0850    -0.0278       0.0744
 55  |       |       |   0.001    0.1692   0.0726    1.1160    0.0473    -0.0155       0.0414
 56  |       |       |   0.006    0.3348   0.1012    1.1481    0.1123    -0.0454       0.1025
 57  |     **|       |   0.074   -1.1519   0.1012    1.1000   -0.3866     0.1561      -0.3527
 58  |       |******|    1.847    7.5162   0.1143    0.2899    2.7003   -1.1552       2.4921
 59  |******|        |   0.815   -3.5320   0.1357    0.8017   -1.3997    0.6416      -1.3094
```

From the output we see that these two data points have values (bold face) that exceed several of the criteria suggested for evaluating undue influence (or leveraging) of the line of best fit.

Therefore, strictly for the purpose of generating a predictive equation, we omitted these values from the linear regression analysis. The reported costs for these two facilities are still included, however, in the cost summation for respondent facilities. The final predictive equation was then obtained and is shown in the output below:

```
Final Regression Model for Predictive Equation

The REG Procedure
Model: MODEL1
Dependent Variable: Report_cost

Number of Observations Read          57
Number of Observations Used          57
```

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1210.67544	1210.67544	47.22	<.0001
Error	55	1410.09428	25.63808		
Corrected Total	56	2620.76973			

Root MSE	5.06341	R-Square	0.4620
Dependent Mean	7.89368	Adj R-Sq	0.4522
Coeff Var	64.14503		

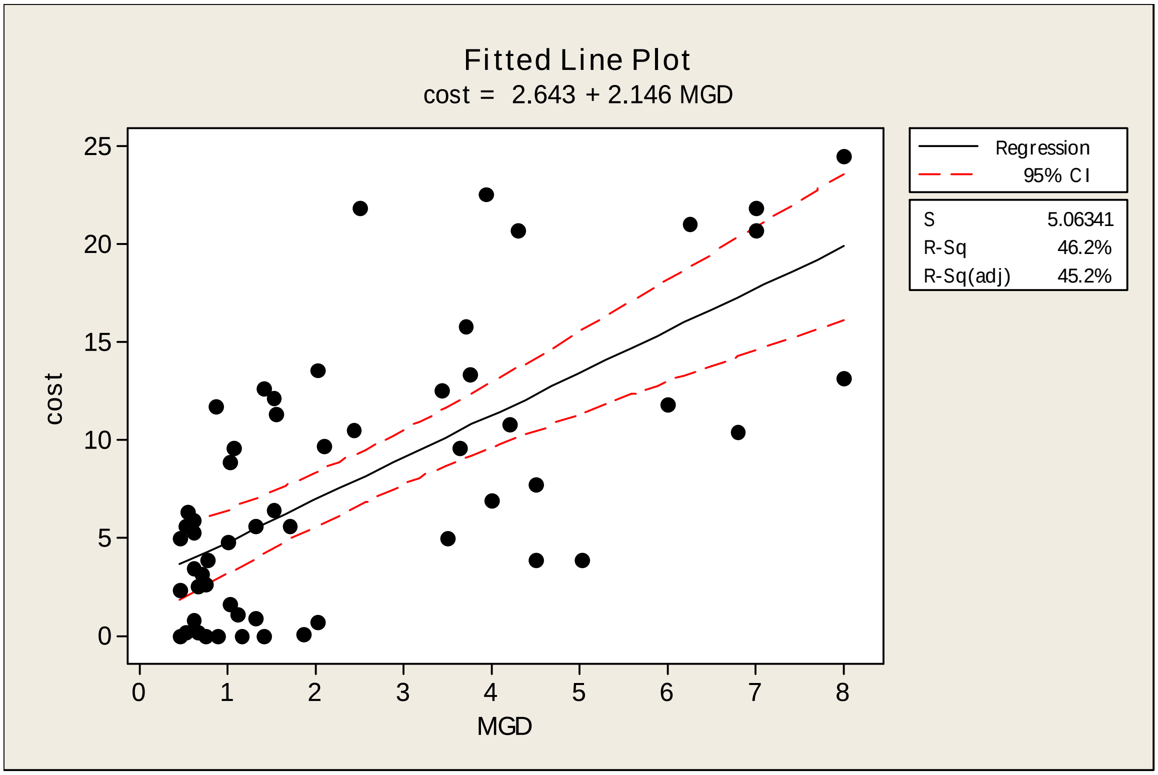
Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2.64350	1.01662	2.60	0.0119
MGD	1	2.14616	0.31231	6.87	<.0001

Extracting the intercept and slope values from the SAS output gives us the following predictive equation:

$$Predicted\ Cost = 2.644 + 2.146(MGD)$$

The coefficient of determination (r^2) for this predictive equation is 0.462, and the test of significance for the regression indicates that it is significant. ($p<0.05$). The fitted predictive equation and its confidence band are shown in the Minitab plot below:



Generating the Predicted Costs for the non-respondent small facilities.

The MGD value for each non-responding Small Facility was then substituted into the predictive equation above and an estimated cost was obtained. These predicted costs were then summed over all the non-responding Small Facilities to give a total estimated cost:

```
Sum of predicted cost for 116 non-responding small facilities

Obs     _FREQ_     predcost

 1        116       714.296
```

The sum of the predicted costs represents an estimate with a margin of error that can be used to construct 95% confidence limits for the estimate. In this case, the MGD for each of the 116 non-respondent facilities produces a predicted cost, and for each predicted cost there is a variance associated with it:

$$\hat{s}_Y^{\,2} = s^2{}_{Y\bullet X}\left[1 + \frac{1}{n} + \frac{(X_{new} - \bar{X})}{\sum (X - \bar{X})^2}\right]$$

Where $s^2{}_{Y\bullet X}$ is obtained as the error mean square from the linear regression, and X_{new} is the MGD of a non-respondent facility. As we then sum the estimates of the predicted costs, we then sum the variances of each of the predicted costs. We then employ the Working-Hotteling method

(Kutner, et al. 2005) to account for covariance between the slope and intercept estimates of the prediction equation to get the 95% confidence interval for the estimated sum:

$$\hat{Y}_{sum} = W * s(\hat{Y}_{sum})$$

Where

$$W = \sqrt{2F_{(.95,2,55)}} = 2.51597$$

and $Ys(\hat{Y}_{sum}) = \sqrt{3070.434}$

Thus, the margin of error for the sum of the predicted costs for the 116 non-respondents is 139.4124. and so the 95% confidence interval for the estimate of 714.296 (+/- 139.4124) is (574.8836 to 853.7084).

Final Cost Determination for the Study.

Summary: Final Cost Determination

Large Facility Total Costs

Obs	_FREQ_	sum_cost
1	8	197.48

Total Costs for Respondent Small Facilities

Obs	_FREQ_	sum_cost
1	59	513.32

Sum of predicted cost for 116 non-responding small facilities

Obs	_FREQ_	sum_pred_ cost
1	116	714.296
TOTALS	183	1425.096 +/- 139.412

The confidence interval for the Final Total Cost is determined strictly by the margin of error associated with the estimated cost of the non-respondent facilities. As a result, the 95 % confidence interval for the estimated Total Cost of $ 1425.096 M is ($ 1285.684 to $ 1564.508 M).

Thank you for bringing your study to the Statistical Consulting Center. If you have any questions regarding the analyses presented here, please feel free to contact us.

We would like to acknowledge the participation of Dr. Jim Rosenberger for assistance in this project.

Sincerely,

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