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Chesapeake Bay Program
Nutrient Trading
Fundamental Principles and Guidelines

Chesapeake Bay Program
A Watershed Partnership

Prepared by:
The Chesapeake Bay Program
Nutrient Trading Negotiation Team

March 2001

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2001

Chesapeake Bay Program

A Watershed Partnership

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Chesapeake Bay Program
A Watershed Partnership

Chesapeake Bay Program Principals' Staff Committee

ENDORSEMENT OF THE NUTRIENT TRADING FUNDAMENTAL PRINCIPLES AND GUIDELINES

The Chesapeake Bay Program convened the Nutrient Trading Negotiation Team in June 1999 to explore the feasibility of nutrient trading for point and nonpoint sources in the watershed and, if appropriate, to develop nutrient trading guidelines. The outcome of the Team's deliberations is presented in a document entitled *Nutrient Trading Fundamental Principles and Guidelines.* The document is intended to be used as a guide for those Bay jurisdictions that choose to establish nutrient trading programs.

The Negotiation Team was composed of a wide array of interested stakeholders from across the Chesapeake Bay watershed—Federal, state and local governments, as well as municipal, industrial, agricultural, environmental and public interests were among those represented. Using a facilitated consensus-based approach, the Negotiation Team derived the nutrient trading fundamental principles and guidelines contained in the document. Fundamental principles represent those elements of a nutrient trading program that the Negotiation Team deemed essential. The guidelines are those elements of a program that the Negotiation Team deemed important for the jurisdictions to consider when developing and implementing a trading program.

The document is based on the Negotiation Team's comprehensive consideration of numerous other trading programs and approaches, substantial research, and corresponding lengthy negotiations. While the document provides parameters of a general framework, individual Bay jurisdictions implementing a trading program will need to determine additional program elements. The document reflects changes made by the Negotiation Team in response to public comment.

The *Nutrient Trading Fundamental Principles and Guidelines* document is accepted and endorsed by the Chesapeake Bay Program partners. It is recognized that if trading programs are developed, each jurisdiction will need to tailor that program in a manner necessary to meet their individual needs and nutrient reduction goals and efforts. However, the enumerated fundamental principals and guidelines in the document will serve as a common organizing and policy framework for the jurisdictions.

FOR THE COMMONWEALTH OF VIRGINIA

FOR THE STATE OF MARYLAND

FOR THE COMMONWEALTH OF PENNSYLVANIA

FOR THE DISTRICT OF COLUMBIA

FOR THE CHESAPEAKE BAY COMMISSION

FOR THE UNITED STATES OF AMERICA

Date: March 26, 2001

PREAMBLE

This document presents fundamental principles and guidelines for nutrient trading in the Chesapeake Bay watershed. The Chesapeake Bay Program convened the Nutrient Trading Negotiation Team (Negotiation Team) in June 1999 for the purpose of exploring the feasibility of nutrient trading for point and nonpoint sources in the Chesapeake Bay watershed and, if appropriate, develop nutrient trading guidelines for the Bay jurisdictions to use on a voluntary basis. The outcomes of the Negotiation Team's deliberations are presented herein. This document is not a regulation. Rather, it is intended to be used on a voluntary basis as a guide for those Bay jurisdictions that choose to establish nutrient trading programs.

The Negotiation Team was composed of a wide array of interested stakeholders from across the Chesapeake Bay watershed—Federal, state, and local governments, as well as municipal, industrial, agricultural, environmental, and public interests, were among those represented. Using a facilitated consensus-based approach, the Negotiation Team derived the nutrient trading fundamental principles and guidelines found in this report. Fundamental principles represent the elements that the Negotiation Team deemed essential for an equitable, environmentally protective, yet viable, trading program. The guidelines are what the Negotiation Team deems important for the jurisdictions to consider when developing and implementing a trading program.

This document is a resource for the user in becoming familiar with, or developing and implementing, a trading program for nutrients. The document is based on the Negotiation Team's comprehensive consideration of numerous other trading programs and approaches, substantial research, and corresponding lengthy negotiations. General guidance is provided in this document: certain program details will need to be determined by individual Bay jurisdictions, should they implement a trading program. This document has undergone public review and revisions were made, according to public comment, where the Negotiation Team deemed appropriate.

Should the signatory states pursue trading programs, the Negotiation Team recommends that the definitions, principles, and guidelines contained in this document be reevaluated two to three years after implementation and actual operation of such programs. A reevaluation should provide the opportunity for trading programs to adapt as reduction goals change, new water quality data becomes available, new technologies evolve, policies such as "smart growth" are implemented, cap strategies are developed, and as tributary strategies are revised. Recognizing

the importance of land use efforts such as “smart growth” in Bay restoration, the Negotiation Team agreed,

1) that if it can be established that trading only within a major Bay tributary substantially constrains “smart growth” or cap strategy or tributary strategy implementation initiatives, and

2) that trading with an adjoining major Bay tributary would yield significant environmental benefits,

then the reevaluation may include a close examination of Fundamental Principle #2[*] to consider the potential for allowing trades across major Bay tributary boundaries. Any changes to the definitions, principles, and guidelines must be adopted through negotiation by consensus in a manner consistent with the adoption of the existing definitions, principles, and guidelines.

[*] See Exhibit 1.2 or Section 3.3 for a definition of Fundamental Principle #2.

HOW TO USE THIS DOCUMENT

It is important for the reader to understand that, due to the very complex nature of this subject matter, this document should be read in its entirety to fully comprehend how all of the facets of a trading program work together and to avoid the meaning of any individual facet from being taken out of context. For example, a reading of the fundamental principles alone will not provide all of the information necessary to accomplish trading. Rather, it is necessary to comprehensively consider the fundamental principles together with the guidelines and supporting options herein to develop a complete trading program.

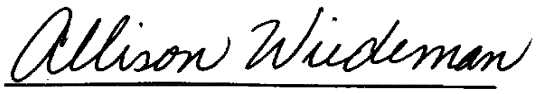
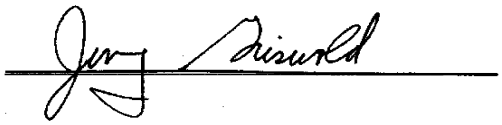
This document is not a regulation but a guide for the states to use on a voluntary basis when developing their own trading programs. Certain words frequently associated with statutes or regulations (e.g., must, should, may, will, etc.) have been carefully used in this report to reflect a hierarchy of importance or strength of the feeling by the Negotiation Team. In this report, the Negotiation Team's use of the words "must" and "will" reflect essential elements of a successful and defensible nutrient trading program, the word "should" reflects the Negotiation Team's strong recommendation for inclusion of such elements in a trading program, and the use of the word "may" reflects optional elements that are worthy of consideration.

Hierarchy of Language Chosen by the Negotiation Team

"Must"	reflects what the Negotiation Team concludes are essential components of a successful and defensible program
"Should"	reflects the Negotiation Team's strong recommendation for inclusion within a trading program
"May"	reflects optional elements the Negotiation Team considers worthy of consideration

The Principles and Guidelines Established in This Document Are Agreed to by Consensus by The Chesapeake Bay Program Nutrient Trading Negotiation Team

February 2001

Primary Negotiators	Stakeholder Group	
Robert Koroncai	U.S. EPA, Region III	
Allison Wiedeman	Chesapeake Bay Program	
Jerry Griswold	Chesapeake Bay Program	
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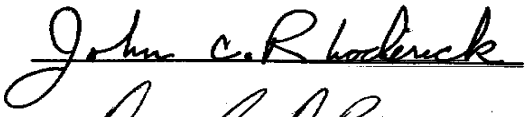
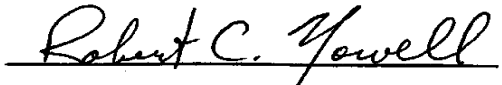
John Rhoderick	State of Maryland	
David Bingaman	Commonwealth of Pennsylvania	
Robert Yowell	Commonwealth of Pennsylvania	
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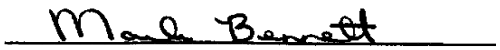
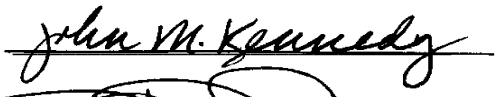
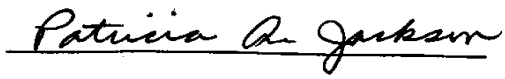
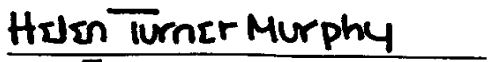
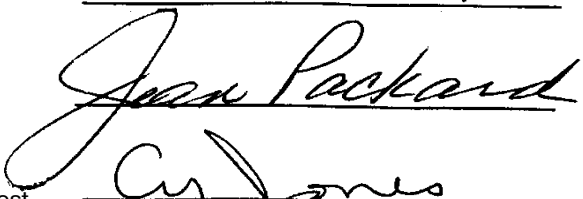
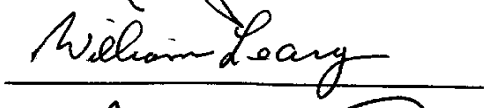
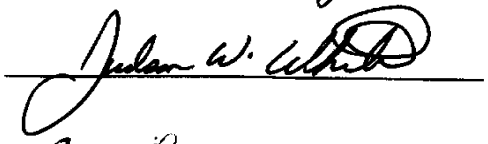
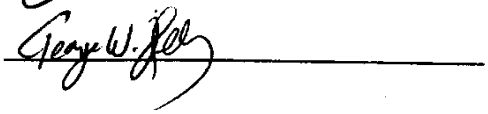
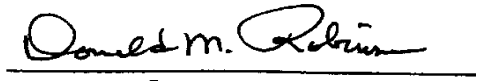
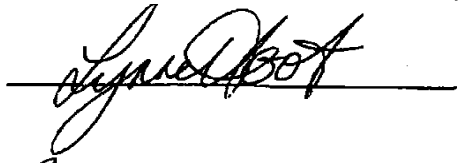
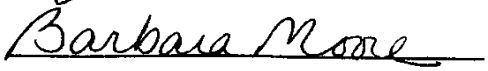
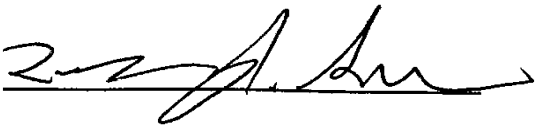
Mark Bennett	Commonwealth of Virginia	
John Kennedy	Commonwealth of Virginia	
Roy Hoagland	Regional Environmental Interest	
Stella Koch	Regional Environmental Interest	

Patricia Jackson	Local Watershed Interest	
Helen Murphy	Public Interest	
Jean Packard	Public Interest	
Cy Jones	Municipal Point Source Interest	
Bill Leary	Municipal Point Source Interest	
Jud White	Industrial Point Source	
George Kelly	Industrial Point Source	
Steele Phillips	Rural Nonpoint Source	
Don Robinson	Rural Nonpoint Source	
Lynne Hoot	Rural Nonpoint Source	
Barbara Moore	Storm Water Interest	
Larry Gavan	Storm Water Interest	

EXECUTIVE SUMMARY

The purpose of this Nutrient Trading Fundamental Principles and Guidelines document is to provide guidance on developing and implementing a nutrient trading program within the Chesapeake Bay watershed. Growing populations and agricultural industries in the watershed have put pressure on our ability to maintain and achieve nutrient reduction goals necessary for the health of the Bay and its living resources. In spite of the many traditional nutrient reduction measures already in effect, such as end-of-pipe technology and Best Management Practices (BMPs), nutrient loads will continue to increase unless new and alternative reduction and maintenance methods and programs are employed. Nutrient trading is viewed as a possible tool among a realm of techniques and actions that may be used to counteract nutrient increases.

In June 1999, the Chesapeake Bay Program organized a multi-stakeholder Nutrient Trading Negotiation Team for the purpose of exploring the feasibility of nutrient trading in the Chesapeake Bay watershed and, if appropriate, prepare guidelines for voluntary use by states in the development of their respective nutrient trading programs. This document presents the results of these discussions and describes fundamental principles and guidelines for nutrient trading as proposed and agreed to by the Negotiation Team. The Negotiation Team recognized that, if designed appropriately, this market-based tool potentially offers a means to achieve pollution reduction in cost-effective and environmentally sound ways. The potential benefits of trading are listed in Exhibit 1.1.

Through a professionally facilitated process, the Negotiation Team came to consensus on a number of fundamental principles and general guidelines aimed at ensuring consistent, compatible, and

Exhibit 1.1 Potential Benefits of Trading
(adapted from U.S. EPA, 1998)

Economic Benefits:

- Reduces costs for individual sources contributing to water quality problems.
- Allows dischargers to take advantage of economies of scale and treatment efficiencies that vary from source to source.
- Reduces overall cost of addressing water quality problems in the watershed.
- Creates market demand for new innovative technologies.

Environmental Benefits:

- Achieves equal or greater reduction of pollution for the same or less cost.
- Creates an economic incentive for dischargers to go beyond minimum pollution reduction and also encourages pollution prevention and the use of innovative technologies.
- Can reduce cumulative pollution loading, improve water quality, accommodate growth, and prevent future environmental degradation.
- Can address the broader environmental goals within a trading area; e.g., ecosystem protection, ecological restoration, improved wildlife habitat, endangered species protection, etc.
- May encourage pollution reduction to occur sooner and at increased rates.

Social Benefits:

- Encourages dialogue among stakeholders and fosters concerted and holistic solutions for watersheds with multiple sources of water quality impairment.

environmentally beneficial approaches between Chesapeake Bay Program jurisdictions and adherence to Chesapeake Bay Program goals and established agreements. Fundamental principles, presented in Exhibit 1.2, represent the highest order of importance and establish the

Exhibit 1.2 Fundamental Principles *

Fundamental Principle #1
Trades must not produce water quality effects locally, downstream, or Baywide that

- violate water quality standards or criteria
- do not protect designated uses

or

- adversely impact living resources and habitat.

Fundamental Principle #2
Trading will be allowed only within each major Bay tributary (i.e., Susquehanna, Potomac, Rappahannock, York, James, Patuxent, Maryland Western Shore, Virginia Western Shore, Maryland Eastern Shore, Virginia Eastern Shore) among all signatory states and nonsignatory states if they adopt the appropriate allowance and are consistent with the Chesapeake Bay Program's nutrient trading guidelines and state tributary strategies.

Fundamental Principle #3
The nutrient trading program must be consistent with Federal, state, and local laws and regulations, be flexible enough to adapt to future changes in these laws and regulations, and enable participation of all potential sources as determined by the market place.

Fundamental Principle #4
The nutrient trading program must be consistent with the Chesapeake Bay Program's nutrient reduction goals and state tributary strategies.

Fundamental Principle #5
Each trade must result in a net reduction in nutrient loadings or contribute to maintenance of a tributary nutrient cap. Net reduction in loadings or maintenance of a cap shall be calculated based upon the estimated tributary loadings at a point in time determined by the state.

Fundamental Principle #6
Sources should implement nutrient reduction actions to achieve the 40% reduction goal, as well as the goals adopted for the tributaries south of the Potomac River prior to pursuing a nutrient trading option.

Fundamental Principle #7
Traders must be in substantial compliance with all local, state, and Federal environmental laws, regulations, and programs.

Fundamental Principle #8
The involvement of a diverse group of stakeholders must be sought in the design and implementation of state trading programs and related public education initiatives.

* Please see Preamble for information on the application of Fundamental Principles.

vital foundation for the program. Fundamental principles are deemed by the Negotiation Team to be essential for an equitable, environmentally protective, yet viable, trading program. Guidelines, presented in Exhibit 1.3, are organized around six key elements of a trading program:

- Identifying nutrient reduction goals
- Determining eligibility
- Performing trade administration
- Ensuring accountability
- Assessing progress
- Involving stakeholders.

These guidelines are what the Negotiation Team deems important for the jurisdictions to consider when developing and implementing a trading program.

Exhibit 1.3 Guidelines

GUIDELINES FOR IDENTIFYING NUTRIENT REDUCTION GOALS

Trading to Achieve or Maintain the Chesapeake Bay Nutrient Cap

1. Trading should be allowed among "like" source types in order to achieve the 40% nutrient reduction goal. This means that point sources could trade with point sources, and nonpoint sources could trade with nonpoint sources, but point sources could not trade with nonpoint sources.

   Within several years after the implementation of a trading program, the states may reexamine the success or failure of trades to date in achieving the goal and, thereafter, determine if cross-source trading to achieve is appropriate.

   Once the 40% nutrient reduction goal is met, trades should be allowed within and across source types to maintain nutrient reduction goals or further reduce nutrient levels.

2. For trading to occur within a major Bay tributary, the nutrient trading program must incorporate (a) specific nutrient loading allocations established to provide water quality conditions necessary to protect living resources in the tributary and the Bay; (b) a baseline and a cap for nutrient loads for the tributary; and (c) allowances for point and nonpoint sources.

GUIDELINES FOR DETERMINING ELIGIBILITY

Guidelines Applicable to All Source Categories

3. Total Nitrogen and/or Total Phosphorus are the forms of nutrients eligible for trading.
4. Eligibility consideration should be given to all potential point and nonpoint sources to the extent allowed under current local, state, and Federal programs.
5. A source may receive credits for reductions in both nitrogen and phosphorus through the operation of a facility or the implementation of a BMP that reduces both nutrients.
6. Entities that are not considered sources may purchase credits (e.g., for the purpose of banking credits or retirement).
7. Any source receiving state or Federal funds to achieve nutrient reductions through the development or installation of any nutrient reduction equipment, technology, or structural BMP cannot buy credits to achieve those reductions. If state or Federal funds are used to cost share nutrient controls that generate credits, only the portion of those credits not paid for by the state or Federal cost share are available for trading.

Exhibit 1.3 Guidelines (Cont'd)

GUIDELINES FOR DETERMINING ELIGIBILITY (CONT'D)

Additional Nonpoint Source Eligibility Guidelines

8. All farmers (sellers) must be following a state certified Nutrient Management Plan to be eligible to participate in trading.

9. All BMPs must meet NRCS standards and be part of a Conservation Plan.

Urban Eligibility Guidelines

10. All nonagricultural nonpoint source storm water systems governed by a state and/or Federal storm water permit(s) are eligible to generate measurable and certified credits for those reductions that exceed permit requirements. For those storm water systems not governed by permit, each must have comparable requirements (to permitted systems) prior to the generation of nutrient reduction credits.

GUIDELINES FOR PERFORMING TRADE ADMINISTRATION

Baywide Program Oversight

11. The Chesapeake Bay Program should have an opportunity to comment on state programs with respect to fundamental principles, consistency, interstate trades, and program effectiveness.

State-Level Program Oversight and Management

12. Each state will be responsible for program oversight and the applicable level of day-to-day program management. These functions should include the following:
    - Establishing policy direction
    - Certifying credits
    - Establishing guidance on eligible trades
    - Registering and tracking the generation of credits, including quantities retired for net water quality benefits
    - Monitoring compliance
    - Enforcing program requirements
    - Evaluating program performance.

Establishment of Central State Coordinating Office

13. A central trading coordinating office should be established within each state to track the administration of trades. The organization may be formed within an existing state government or formed from a conglomerate of state and local stakeholders.

Trade Ratios

14. Each trading program should address the following ratios:
    - Delivery ratios
    - Special needs ratios
    - Retirement ratios
    - Uncertainty ratios.

Trade Facilitation

15. Each trading program should address trade facilitation, including those activities that support the negotiation and recording of completed trade transactions. Specific activities and roles should be determined by the states.

Exhibit 1.3 Guidelines (Cont'd)

GUIDELINES FOR ENSURING ACCOUNTABILITY

Guidelines for Assessing Performance

Point Sources

16. Self monitoring and reporting of nutrient reduction should be required for participants in the trading program.

Nonpoint Sources

17. All nonpoint source controls should be inspected to ensure the control is properly sited, the materials and plans satisfy established quality specifications, and the installation job meets performance standards.

18. All nonpoint source controls should undergo an annual on-site assessment by a qualified inspector to ensure proper functionality (e.g., look for signs of sedimentation and erosion to identify inefficient BMPs). In addition, the nonpoint source should allow right of entry by the state or its designated agent, and the states should use scheduled spot check inspections to supplement scheduled random inspections.

States

19. States will be responsible for performing, collecting, and analyzing ambient water quality monitoring and overall program assessment.

20. In addition to ambient water quality monitoring, states should include other types of data (e.g., weather patterns, slope, soil types, effluent monitoring data) to predict the effectiveness of trades, to assess whether trades are meeting and maintaining water quality standards, and whether traders are meeting applicable limits.

Guidelines for Account Balancing

Point Sources

21. Point sources will monitor and report on a monthly basis. A yearly accounting period should be used to assess the trade.

22. Point sources should have mechanisms in place to calculate the credits or portions of credits eligible for trading.

Nonpoint Sources

23. Annual account balancing periods should be used for nonpoint sources based upon seasonal monitoring.

24. Nonpoint sources should have mechanisms in place to calculate the credits or portions of credits eligible for trading.

Guidelines for Enforcement and Compliance

General

25. The trading agreement will be enforceable by the state. After considering a variety of options, including general state permits, state regulations, and contracts, the Negotiation Team strongly recommends that trades should be governed by a state general permit or regulation issued under the state's water quality laws (versus Clean Water Act) and that the public will be provided opportunity for input prior to the execution of a trade. If a state elects to utilize a contract as a vehicle for enforcement, the contract development and enforcement processes must provide the same elements as if within the state's regulatory or general permit program, including public participation prior to the execution of a trade. Any NPDES permittee with a nutrient effluent permit limit desiring to trade should have the trade linked to its permit.

Point Sources

26. The state will maintain oversight of facility monitoring and reporting and will perform periodic compliance checks. The state will have full compliance and enforcement responsibilities, such as those performed under existing Clean Water Act programs and protocols.

Exhibit 1.3 Guidelines (Cont'd)

GUIDELINES FOR ASSESSING PROGRESS

Monitoring Trades and Trading Impacts

27. States will perform ambient monitoring and modeling to assess the effect of trading programs in achieving or maintaining baywide (e.g., 40% reduction goal) and tributary specific nutrient reduction goals. These monitoring and modeling efforts should build upon existing efforts currently used by states and trading participants. Point sources involved in nutrient trading must monitor and report total nitrogen and total phosphorous discharges as applicable to the trade. Nonpoint source monitoring should be conducted to provide sufficient data to demonstrate the effectiveness of trading actions. If monitoring is not utilized, then nonpoint source pollutant loading reductions will be determined based upon data and analysis obtained from the Chesapeake Bay Program's Watershed Model. If the modeling approach is used, trading ratios must be applied to accommodate for uncertainty.

State Tracking Mechanisms

28. States must develop mechanisms to collect and track trading information that is compatible with existing mechanisms used by the Bay Program for assessing progress toward achieving and maintaining nutrient reduction goals (e.g., watershed model, BMP tracking system, environmental indicators, State of the Bay Report). Tributary-specific information must be collected by the state and aggregated to demonstrate how trading supports the achievement and maintenance of nutrient reduction goals. Information requirements include the following:
    - Total annual load reduction of nitrogen and phosphorous
    - Total annual load reduction of nitrogen and phosphorous by type of trade (p-p, p-nps, nps-p, nps-nps)
    - Total annual load reduction of nitrogen and phosphorous by discharger type (point source, agricultural, and urban nonpoint sources)
    - Net loading reduction of nitrogen and/or phosphorous generated by trading partners
    - Comparison of pre-trading water quality conditions to post-trading water quality conditions
    - Total number of trades made
    - Total annual number of trades
    - Determination of whether cumulative effects of the trading program are contributing to achieving tributary strategy goals.

Reporting Baywide Progress

29. The Chesapeake Bay Program must provide a similar Baywide analysis (as outlined under the State Tracking Mechanisms guideline) based on the trading information it receives from the states.

Evaluating Accountability, Compliance, and Enforcement

30. States must track the actions of trading partners, compliance with trade agreements, and any enforcement action taken. Information requirements for each tributary watershed and the state include the following:
    - Total annual number of trading partners subject to periodic compliance checks
    - Total annual number of trading partners deemed to be out of compliance with existing regulatory requirements
    - Total annual number of trading partners deemed to be out of compliance with the terms of their trade agreement
    - Total annual number of trading partners that corrected noncompliance issues
    - Total annual number of trades subject to enforcement penalties.

Establishment of a Central Coordinating Office

31. The central coordinating office, as described under the Guidelines for Performing Trade Administration, will be responsible for the state's responsibilities contained in these Assessing Progress guidelines.

Additional Information to be Provided by Buyer

32. Buyers of credits must provide available information and reason(s) for trades, including the following:
    - Credit price
    - Timeframe of trade
    - Nutrient reduction (in lbs)
    - Existing cost savings estimates.

Exhibit 1.3 Guidelines (Cont'd)

GUIDELINES FOR INVOLVING STAKEHOLDERS

33. Each state should create or use existing citizens advisory committees to be part of the nutrient trading program within each state.

34. Each state may choose to create a demonstration program.

35. States should provide broad public notification of trades as they occur, including notification to local watershed groups.

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1.0 Introduction

This report presents the outcomes from the Chesapeake Bay Program Nutrient Trading Negotiation Team's deliberation process on the feasibility of nutrient trading in the Chesapeake Bay watershed. It is meant to serve as a nonprescriptive guide for Chesapeake Bay watershed states to use in developing their nutrient trading programs, as they deem appropriate. The report will also aid potential trading participants in understanding the concept of trading and the expected process for trading in the Bay.

A draft of these guidelines was made available to the public for review on September 8, 2000. A series of 16 public meetings were held in a variety of locations across the watershed for the purpose of educating the public on these guidelines. One hundred and eighteen (118) written comment letters were received prior to the close of the comment period on October 27, 2000. The Nutrient Trading Negotiation Team (Negotiation Team) considered these comments and made changes where appropriate. A summary of these comments, along with a description of the major commenter issues and the changes made by the Negotiation Team after consideration of these comments, has been compiled and is entitled "Summary of Public Comments Submitted on the Chesapeake Bay Program Nutrient Trading Fundamental Principles and Guidelines." See Appendix A for a synopsis of the public meetings, public comments, and responses to these comments.

Using a consensus-based process, the Negotiation Team identified **key definitions**, **fundamental principles**, and **guidelines** for a Chesapeake Bay nutrient trading program. In addition, the Negotiation Team identified **implementation options** for specific elements of a trading program. Recognizing the differences among jurisdictions in the watershed, options are presented to provide ideas that will help entities identify the best approach for their situation. The options were developed from research and case studies—they are not based on consensus.

This report begins by providing detailed background information on nutrient reduction activities in the Chesapeake Bay watershed and explains the reasons for considering nutrient trading as a tool to assist in nutrient reduction. This report continues by presenting definitions and fundamental principles agreed upon by the Negotiation Team. A description of the six elements of a trading program follows in Sections 4.0 through 9.0. These sections contain the guidelines the Negotiation Team concluded were important factors to consider, should the Bay jurisdictions pursue nutrient trading. Section 10.0 discusses future steps recommended prior to developing a large watershed trading program.

2.0 Background

One of the greatest water quality challenges facing the Chesapeake Bay is excess nutrients. This overabundance of phosphorus and nitrogen in Bay waters is a form of pollution that harms the Bay's aquatic life and other living resources (see Exhibit 2.1).

Exhibit 2.1 The Effects of Nutrient Over-Enrichment

Excess nutrients may cause the excessive growth of microscopic floating plants called algae. When algae populations explode, or bloom, the water becomes cloudy and blocks light to submerged aquatic vegetation (SAV). Without enough light, SAV dies. Because SAV provides food and shelter for many Bay animals, such as crabs and fish, this results in wide-spread damage to the Bay.

Algae blooms from excess nutrients also cause another problem—reduced oxygen levels in the Bay's waters at certain times of the year. Oxygen is necessary for all Bay life, but each summer as dying algae from the spring blooms sink, they are consumed by microscopic animals and bacteria in a process that uses up oxygen in the water. This algae decay, plus hot summer weather, often rob the Bay's deep waters of life-giving oxygen. If oxygen levels fall too low, Bay organisms can die.

In response to this growing problem, key government entities in the Bay region—Maryland, Pennsylvania, Virginia, District of Columbia, U.S. Environmental Protection Agency, and the Chesapeake Bay Commission—signed the Chesapeake Bay Agreement in 1983. This agreement established a cooperative approach to addressing the Bay's problems and initiated the voluntary partnership between citizens in the scientific community and governments at local, state, and Federal levels known as the Chesapeake Bay Program.

In 1987, the original agreement was strengthened with the signing of a new Bay Agreement that set a goal to reduce the controllable nitrogen and phosphorus loads entering the Bay by 40% from 1985 levels by the year 2000. Each of the signatory jurisdictions that signed these agreements (Maryland, Virginia, Pennsylvania, District of Columbia) proceeded to develop "tributary strategies," which presented their approach to meeting the reduction goals. After almost two decades of concentrated effort, the signatories to the Chesapeake Bay Agreement recently reaffirmed their partnerships and recommitted and strengthened their efforts in the June 2000 signing of Chesapeake 2000. By far the most comprehensive and far-reaching of the three Bay Program agreements, it reaffirms the commitment to achieve and maintain the 40% nutrient reduction goal agreed to in 1987, as well as specific tributary strategies goals. In fact, the 2000 Agreement's goal is to delist the Chesapeake Bay from the impaired water bodies list for nutrients and sediments by 2010. As part of this goal, by 2003, new tributary strategies will be revised to reflect new load reductions for nitrogen and phosphorous assigned to each major tributary based on water quality conditions necessary to protect aquatic living resources.

Studies performed as part of the 1997 Reevaluation of the Nutrient Reduction Goal and in support of the Chesapeake 2000 initiative show that it is necessary to go beyond reduction approaches implemented to date and think creatively about additional, new, and alternative reduction methods. One option the Chesapeake Bay Program is considering, which is the focus of this document, is nutrient trading. Simply stated, nutrient trading is the transfer of nutrient reduction credits, specifically nitrogen and phosphorus, between buyers (entities that purchase nutrient reduction credits) and sellers (entities that offer nutrient credits for sale). After evaluating the range of nutrient reduction techniques utilized thus far in Chesapeake Bay restoration efforts, the Chesapeake Bay Program found that although it was getting close to meeting the 40% Nutrient Reduction Goal, it may fall short of fully achieving the goal, even with full implementation of current approaches. New techniques, such as nutrient trading, may provide an additional tool needed to close the gap. In keeping with its program philosophy of voluntary, collaborative cooperation among the watershed's jurisdictions, the Bay Program's effort to develop nutrient trading guidelines seeks to maximize state flexibility while ensuring consistent and compatible approaches that are in keeping with overall Bay Program goals.

The remainder of this chapter discusses the motivation for a trading program in the Chesapeake Bay watershed, the closing of the gap with market-based approaches, Federal and Chesapeake Bay trading initiatives, and the approach to developing nutrient trading guidelines for the Chesapeake Bay.

2.1 Motivation for a Trading Program in the Chesapeake Bay Watershed

Although great progress has been made in reducing point and nonpoint source nutrient pollution to the Chesapeake Bay, more needs to be accomplished to meet Chesapeake Bay Program reduction goals. This is especially critical as population pressures continue to mount throughout the watershed. Between 1970 and 1997, the watershed's population increased by 28% to 15.1 million people (U.S. EPA Chesapeake Bay Program, 1999). This trend is expected to continue well into the future. New people will exert additional pressures on the Bay's fragile ecosystem. For example, more and more wastewater will be discharged to already strained wastewater treatment plants. These population increases, and their ancillary effects on community infrastructure, land use patterns, and pollution generation, will make it difficult to meet Chesapeake Bay Program goals or even to hold the line in the future. The Chesapeake Bay Program and its partners will need every tool at their disposal.

In addition to ongoing Chesapeake Bay Program efforts to reduce nutrient pollution, U.S. EPA is working with states across the country on the development of the Total Maximum Daily Load (TMDL) regulations. Unlike the tributary strategies that are part of the voluntary framework of the Chesapeake Bay Program, TMDLs are part of the Clean Water Act's regulatory framework.

Section 303(d) of the Clean Water Act addresses waterways that are not "fishable and swimable" by requiring states to identify those waters and develop TMDLs for them, with oversight by U.S. EPA. Implementation of TMDLs then requires that point and nonpoint sources reduce pollutants to achieve the pollutant loadings established by the TMDL through a variety of Federal, state, tribal, and local authorities, programs, and initiatives. Trading is one option that can occur under a TMDL framework since a TMDL establishes the loading capacity of a defined watershed area and thus the allocation for that area.

Each jurisdiction within the Chesapeake Bay watershed is confronting the issue of TMDLs and is in varying stages of implementing TMDLs for impaired water bodies. In addition, Chesapeake 2000 addressed TMDLs. The new Agreement contains a commitment to remove the Bay from the list of impaired waters by 2010 with a goal of precluding the need to develop regulatory-based TMDLs for nitrogen and phosphorus.

2.2 Closing the Gap with Market-Based Approaches

Market-based approaches to environmental management, such as watershed-based trading, have the potential to enhance the suite of traditional approaches and achieve the needed reductions in nutrient loadings. The driving force behind market-based approaches differs from traditional approaches to environmental management. In a market-based approach, participants determine how best to meet a particular goal. The focus moves from compliance to performance. Market-based approaches use competition to increase efficiency and cost-effectiveness by letting the market determine which source can best reduce pollution without prescribing how to achieve the reduction.

Trading programs are emerging in a variety of locations nationwide as a means to achieve pollutant reductions in cost-effective and environmentally sound ways. In simple terms, trading programs provide a mechanism for determining the most cost-effective means of nutrient reduction via the process of buying and selling pollution reduction credits—in the case of the Chesapeake Bay, nutrient reduction credits. Through this program, the seller of the credits provides cost-effective means of removing or preventing additional pollutant discharges and the buyer of the credits has access to these more affordable means. Central to this kind of system is that overall pollution discharge is not increased within a particular area—the total pollution control requirements in an area such as a watershed or subbasin will be met, but the aggregate cost of compliance across nutrient sources is reduced (Stephenson et al., 1995).

There are several different types of trading programs used throughout the country. Point-to-point trading programs enable trading between individual point sources (e.g., between wastewater treatment plants), point-nonpoint nutrient trading systems refer to trading opportunities between

point source dischargers (e.g., wastewater treatment plants) and nonpoint sources (e.g., a farming operation), and nonpoint-nonpoint trading may occur between nonpoint sources such as agricultural operations. The most appropriate type of trading program for an area depends on factors such as the type of sources within a location (e.g., point sources vs. nonpoint sources), discharge limitations placed on those sources through mechanisms such as discharge permits, and whether a limitation or "cap" for a pollution load over a geographic area exists.

Trading programs are a market-based approach to environmental protection, intended to result in a more equitable, efficient, cost-effective means to address water quality problems. They may encourage pollution reduction to happen sooner and at increased rates. As such, trading programs supplement existing regulatory and nonregulatory approaches to control pollutant discharges. It is a tool used in water resource management for which all watershed pollutant sources, both point and nonpoint, contribute to reducing pollutant without any one source bearing an excessive financial burden.

Trading is also considered an innovative way for community stakeholders (e.g., regulated sources, nonregulated sources, regulatory agencies, and the public) to develop more "common sense" solutions to water quality problems in their watersheds. According to U.S. EPA's Effluent Trading in Watersheds Policy Statement, trading potentially offers a number of economic, environmental, and social benefits (see Exhibit 2.2).

Exhibit 2.2 Potential Benefits of Trading
(adapted from U.S. EPA, 1998)

Economic Benefits:
- Reduces costs for individual sources contributing to water quality problems.
- Allows dischargers to take advantage of economies of scale and treatment efficiencies that vary from source to source.
- Reduces overall cost of addressing water quality problems in the watershed.
- Creates market demand for new innovative technologies.

Environmental Benefits:
- Achieves equal or greater reduction of pollution for the same or less cost.
- Creates an economic incentive for dischargers to go beyond minimum pollution reduction and also encourages pollution prevention and the use of innovative technologies.
- Can reduce cumulative pollution loading, improve water quality, accommodate growth, and prevent future environmental degradation.
- Can address the broader environmental goals within a trading area; e.g., ecosystem protection, ecological restoration, improved wildlife habitat, endangered species protection, etc.
- May encourage pollution reduction to occur sooner and at increased rates.

Social Benefits:
- Encourages dialogue among stakeholders and fosters concerted and holistic solutions for watersheds with multiple sources of water quality impairment.

2.3 Federal and Chesapeake Bay Trading Initiatives

The Federal government has long considered trading a potential approach in a suite of environmental management tools. U.S. EPA, for example, has studied the idea of trading programs as cost-effective tools for achieving water quality objectives for almost 20 years (Podar, 1996). Trading gained increased attention when President Clinton and Vice President Gore publically

promoted market-based approaches to environmental management through the Reinventing Environmental Regulation strategy released in 1995.

As a result of this strategy, U.S. EPA issued a Policy Statement in early 1996 that reaffirms U.S. EPA's support of watershed-based trading programs, describes the types of trading systems, and outlines the benefits associated with trading. The 1996 Policy Statement described how U.S. EPA will promote watershed-based trading:

> "EPA will actively support and promote effluent trading within watersheds to achieve water quality objectives, including water quality standards, to the extent authorized by the Clean Water Act and implementing regulations. EPA will work cooperatively with key stakeholders to find sensible, innovative ways to meet water quality standards quicker and at less overall cost than with traditional approaches alone. EPA will assure that effluent trades are implemented responsibly so that environmental progress is enhanced, not hindered" (U.S. EPA, 1996a).

In May 1996, U.S. EPA published the *Draft Framework for Watershed-Based Trading* intended for local and national community groups, members of the regulated and nonregulated community, and governmental organizations. This framework provides background information on trading; describes the conditions necessary for a successful trade; gives a template of issues (e.g., regulatory, economic, scientific, institutional, etc.) that facilitates the identification and evaluation of trading opportunities; and provides worksheets and checklists to evaluate if potential trades meet threshold conditions (U.S. EPA, 1996b).

The states of Maryland, Virginia, and Pennsylvania also are exploring the possibility of nutrient trading as an additional tool in their nutrient reduction efforts.

Maryland

In August 1997, the Maryland Department of the Environment (MDE) developed a trading concept paper entitled "Maryland Department of the Environment Concept Paper for a Nutrient Trading Policy" in an effort to address the issue of allowing for continued development of municipal wastewater treatment plants while still meeting the Chesapeake Bay nutrient reduction goals. At this point, the concept paper remains a draft document.

The Water Environment Research Foundation is also sponsoring a study to design a trading program for Maryland. This project is being performed in consultation with Maryland stakeholders including MDE, the Maryland Department of Agriculture, the Maryland Department of Natural Resources, and the Maryland Association of Municipal Wastewater Agencies.

Trading scenarios will involve point-to-point or point-to-nonpoint sources. This study is expected to be completed in the Spring of 2001.

Virginia

The Virginia Water Quality Improvement Act includes a clause that requires investigation of trading as a means to meet its goals. The Virginia Department of Environmental Quality (DEQ) is currently in the process of working with stakeholders to develop a point-to-point source trading program in Virginia. DEQ is working with the Virginia Water Resources Resource Center to hold stakeholder meetings for this purpose. DEQ has also formed a Water Resources Committee consisting of stakeholder groups to advise the DEQ Director on matters relating to Virginia's water resources. One of the topics this group plans to address is trading.

Pennsylvania

U.S. EPA sponsored an effort to simulate trading programs for several Bay basins in Pennsylvania for which TMDLs have been developed. A workgroup of Pennsylvania stakeholders was formed to assist in this project, including the Pennsylvania Department of Environmental Protection (PADEP), the Chesapeake Bay Foundation, the Pennsylvania Municipal Authority Association, and the Chesapeake Bay Program. The product of this endeavor, completed in September 1999, was to develop a manual to elaborate on issues regarding point/nonpoint source trading (U.S. EPA, 1999). Additionally, the state legislature endorsed a resolution on February 9, 2000, expressing an interest in pursuing trading.

2.4 Approach To Developing Nutrient Trading Guidelines for the Chesapeake Bay

Working within the framework of the Chesapeake Bay Program, the Trading and Offsets Workgroup (TOWG) of the Nutrient Subcommittee convened a team of Bay watershed stakeholders (the Negotiation Team) to further examine the concept of nutrient trading.

The Negotiation Team included representatives from major stakeholder groups throughout the Chesapeake Bay watershed that were interested in and/or affected by a potential nutrient trading program. The following interests were represented:

- Virginia, Maryland, Pennsylvania, and the District of Columbia
- Regional environmental interests
- Local watershed interests
- Local government interests

- Public interests
- Municipal and industrial point source interests
- Rural and urban nonpoint source interests
- Stormwater interests
- Chesapeake Bay Program
- U.S. Environmental Protection Agency.

Full membership is presented in Appendix B.

The Negotiation Team met intensely for more than a year between June 1999 and August 2000. The Negotiation Team was charged with examining the concept of nutrient trading, and if appropriate, developing recommendations for nutrient trading guidelines. Each signatory to the Chesapeake Bay Agreement has different geographic, social, and economic conditions and, accordingly, are taking different approaches to reducing nutrients to achieve Chesapeake Bay Program goals. Therefore, the Negotiation Team's efforts were to provide guidelines, not prescriptions, to ensure that nutrient trading approaches in the Chesapeake Bay watershed are consistent and compatible between jurisdictions and fully supportive of Chesapeake Bay Program goals.

The Negotiation Team used an educational and consensus-based approach for exploring nutrient trading and developing guidelines. Significant time was spent developing an understanding of nutrient trading concepts, reviewing approaches and lessons learned from other areas, and considering how this information could be applied in the Chesapeake Bay.

Consensus-Based Approach

The first meeting of the Negotiation Team (June 30, 1999) adopted ground rules for the negotiation process, including the following definition of consensus: "*Consensus* means that all the negotiators would agree they could accept the proposed option or guideline, even if a negotiator might prefer a different position, and be willing to make compromises that satisfy the interests of their constituents to help the team move forward."

Throughout the guidelines development process, the Negotiation Team worked with trained facilitators to develop consensus on the structure and content of the Chesapeake Bay nutrient trading guidelines. Consensus-based guidelines were developed for the following aspects of a trading program:

- Fundamental principles
- Definitions
- Identifying nutrient reduction goals
- Evaluating eligibility
- Performing trade administration

- Ensuring accountability
- Assessing progress
- Involving stakeholders.

Negotiation Team members met in small groups to deliberate specific questions associated with the above topics and to develop recommendations to bring back to the plenary session. Plenary sessions were used to review small group recommendations and to come to a group consensus on what to incorporate into the guidelines. This iterative process of small group work and plenary sessions was supplemented by review and agreement on the draft fundamental principles and guidelines document. The guidelines presented in this document represent the results of this cumulative effort.

3.0 Foundations for Nutrient Trading in the Chesapeake Bay

Several key components provide the foundation for developing effective nutrient trading guidelines for the Chesapeake Bay. Because the watershed encompasses multiple jurisdictions and potentially many participants in a trading program, it is necessary to use a common language and adopt common definitions to support development of consistent and compatible programs. Although each jurisdiction is unique, some level of consistency and compatibility is necessary to ensure that Chesapeake Bay Program goals, including the capability to monitor and report progress, are met.

It is also necessary to have a clear idea of what geographic area a trading program will address. The geographic area covered by a program—the program scope—is an important consideration for local water quality. As the distance between trading partners increases, the ability to focus on local water quality may become more difficult; however, if the geographic area is too restrictive, the number of potential trading partners and the incentives for trading may decrease to a level where the program is no longer viable. Concerns about local water quality may be accommodated through an effective trading framework that carefully addresses participant eligibility, program monitoring, and accountability.

An effective trading framework must address a range of issues that will drive the program from inception to completing a trade to monitoring program effectiveness and water quality results. Each element in the framework provides the opportunity for developing discrete guidelines that will support a properly operating trading system. The Negotiation Team considers six elements as providing the framework for the Chesapeake Bay nutrient trading guidelines—identifying nutrient reduction goals, determining eligibility, performing trade administration, ensuring accountability, assessing progress, and involving stakeholders.

3.1 Key Definitions

Nutrient trading is an emerging environmental management approach. As such, terminology is still evolving and often similar terms have different meanings from one program to the next. Definitions for key trading terms provide the building blocks for a trading framework and guidelines. Because of this, the Negotiation Team felt it important to use the consensus process to adopt common definitions. Exhibit 3.1 summarizes the key definitions for a trading framework. A full set of definitions is presented in Appendix C. The definitions presented in Exhibit 3.1 have guided the Negotiation Team's discussions and should be incorporated into any framework developed for trading in the Chesapeake Bay. The following narrative demonstrates how these definitions apply in a Chesapeake Bay trading framework.

Nutrient ***trading*** is the transfer of nutrient reduction credits, specifically nitrogen and phosphorous, between ***buyers*** (entities that purchase nutrient credits) and ***sellers*** (entities that offer nutrient credits for sale). ***Credits*** become available when a seller has reduced its nutrient load below what it is allowed to discharge to the receiving water body. The allowable nutrient load a source may discharge is referred to as an ***allowance***.

Exhibit 3.1 Key Definitions

Allowance	The allowed nutrient load a source may discharge.
Baseline	The numeric level of nutrient load at a particular point in time that serves to establish nutrient reduction goals and allowances.
Buyer	An entity that purchases nutrient credits.
Cap	The total nutrient load that is allowed to be discharged into a given water body. The cap is the baseline minus the amount of load reduction needed to meet the goal. The cap is equal, or greater than, the sum of the allowances.
Credits	The amount of nutrient load reduced below the allowance.
Nutrient Trading	The transfer of nutrient reduction credits, specifically those for nitrogen and phosphorous.
Seller	An entity that offers nutrient credits for sale.
Source	A nutrient source whether point, nonpoint, or third party. The Negotiation Team agreed to use the term "source" in place of "discharger."

For example, if a point source is able to reduce nitrogen below what it is otherwise required to do, it may sell that reduction in the form of credits to another source (possibly another point source or a nonpoint source) that cannot meet its requirements (either because of cost, technology limitation, water quality requirements, etc.). For a trading system to work, credits need to be quantified and expressed in a common unit of measurement so that they may be measured, monitored, and tracked. Typically, flow and concentration are required to quantify an allowance and/or credit, resulting in total nutrient load (expressed as pounds, tons, kilograms, or some other unit of measurement—typically pounds) per unit of time (e.g., day, month, year). In the case of nonpoint sources, the load may have a spatial component as well (e.g., pounds/acre/year).

3.1.1 Trading and Cap Issues

In the Chesapeake Bay watershed, allowances and credits are generated because a limitation, or ***cap***, was placed on the amount of nutrients that could be discharged in the watershed. As described in Chapter 2.0 of these Guidelines, the Chesapeake Bay Program established a 40% Nutrient Reduction Goal from 1985 levels for the controllable loads of nitrogen and phosphorus entering the Chesapeake Bay by the year 2000. The year 1985 was selected as the ***baseline***—the numeric level of nutrient load into a given water body at a particular point in time—for determining the nutrient reduction goal. A baseline is the starting point from which nutrient reduction goals and allowances are established. The Negotiation Team adopted the 1985 baseline as established by the 1987 Chesapeake Bay Agreement. Subsequent agreements or actions such as the Chesapeake 2000 Agreement or the adoption of a TMDL regulatory

framework could establish alternative baselines for the Chesapeake Bay Program's nutrient trading framework. Therefore, the Negotiation Team decided that it is imperative that the program be flexible to accommodate potentially changing baselines and caps.

The 40% reduction goal provided the basis for which the baywide nutrient cap was determined. Similarly, it formed the basis for establishing tributary-specific nutrient reduction goals and caps that are expressed in the Tributary Strategies for each of the 10 major tributary basins in the Chesapeake Bay watershed (see Exhibit 3.2).

3.1.2 Types of Trades

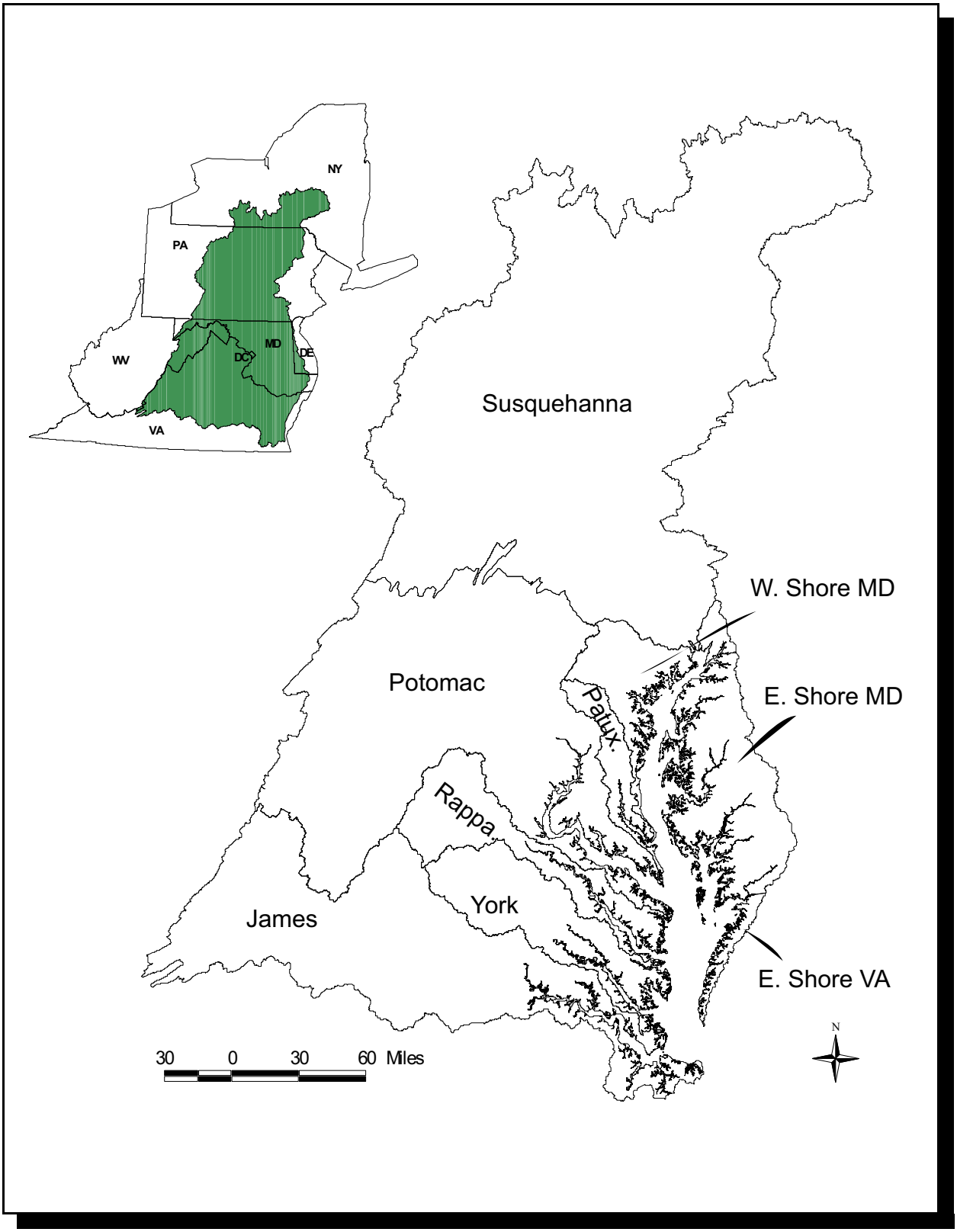
Nutrient trading can incorporate point or nonpoint sources of nutrients. Point sources are pipes or other fixed, discrete conveyances that discharge directly into water. Typically, point sources are regulated under the Clean Water Act. Sewage treatment plants are the main point source of nutrients to the Chesapeake Bay.

Nonpoint sources of nutrients are more diffuse—either washed off the land, leached into ground water, or deposited from the air. Agriculture, especially crop fertilization and livestock production, contributes most of the nonpoint source nutrients to the Chesapeake Bay, although runoff from urban and suburban areas is a growing problem. Most nonpoint sources are not regulated, although they may participate in a variety of incentive and other nutrient reduction programs (e.g., agricultural cost share) or be required to submit and implement nutrient management plans.

In developing these Guidelines, the Negotiation Team considered point and nonpoint sources of pollution. Four possible trading opportunities can occur: point-point, point-nonpoint, nonpoint-point, and nonpoint-nonpoint. In a point-point system, allowances are created and assigned to discrete point sources and trading may occur between those sources provided the fundamental principles and guidelines are met. For example, a wastewater treatment plant could trade with another wastewater treatment plant. Point-point trading is the easiest to quantify because monitoring programs are more established and the location of discharges is confined to a discrete conveyance.

Point-nonpoint/nonpoint-point trading expands the opportunities for trading by enabling point sources and nonpoint sources to participate. Again, each source must have an allowance to determine the availability of, or need for, credits. In this scenario, a point source will seek to obtain credits from a nonpoint source. For example, a point source operator may pay a farmer to implement a BMP that will more cost-effectively reduce the total nutrient discharge (Stephenson et al., 1995). It is also conceivable that nonpoint to point source trading could occur.

Exhibit 3.2 Ten Major River Basins of the Chesapeake Bay Watershed



Nonpoint-nonpoint trading refers to trading between nonpoint sources, such as two farmers. If one farmer wanted to expand production or use different techniques that would increase the nutrient discharge above his/her allowance, the farmer would seek another nonpoint source, likely another farmer, who had credits to sell because his/her nutrient load was below the allowance—possibly due to innovative BMPs. Nonpoint source trading is the most difficult to quantify and measure because it is difficult to monitor these diffuse sources of nutrients. Often programs use the efficiency of BMPs (e.g., amount of load reduction per a given BMP) as a starting point for determining the availability of credits.

3.2 Geographic Scope

An important element of a Chesapeake Bay trading program is the geographic scope, or areal extent and spatial boundaries, of the program. Geographic scope can encompass many different options and scales (e.g., between or within various government jurisdictions, such as counties or states; between or within watersheds of varying sizes). In order to maximize program participation, a larger geographic scope is useful. On the other hand, the farther the trading partners are from each other, the more difficult it is to ensure that local water quality goals are met. The geographic trading boundary must also allow for efficient administration of credit exchange.

The Negotiation Team adopted the Chesapeake Bay Program's 40% Nutrient Reduction Goal as the basis for the trading program's cap. Because this trading framework requires the assignment of consistent and equitable allowances derived from the cap, trading will only be allowed among sources from signatory states (Maryland, Pennsylvania, Virginia, and the District of Columbia). Trading opportunities may be expanded to include a non-signatory state if that state adopts an appropriate allowance set by the Chesapeake Bay Program and adheres to the Chesapeake Bay Program's nutrient trading guidelines presented in this document.

Trading may occur between states as long as the trade is within the major tributary boundaries, such as between Maryland and Virginia in the Potomac River basin. According to Fundamental Principle #2 below, however, trading would not be allowed between different basins in different states, such as between the Susquehanna and the Potomac Basins.

Using watershed boundaries as a starting point, trading will be allowed within a particular tributary among all signatory states and nonsignatory states if they meet all fundamental principles and trading guidelines. Additional scope considerations are described below in Fundamental Principle #2.

3.3 Fundamental Principles

Fundamental principles are the key criteria that must be met for a successful and defensible nutrient trading program. They help to define and clarify key assumptions underlying the Chesapeake Bay Program's nutrient trading guidelines and provide a critical foundation that can be applied when determining the appropriateness of a trade. The Negotiation Team felt the fundamental principles to be the backbone of a trading program and spent a considerable amount of time negotiating these principles to arrive at a consensus. Note that the first fundamental principle essentially states that local water quality will not be impacted by trades. This is an overarching theme that any trading program must incorporate when considering trade location and nutrient credit exchanges. Implementation of this principle will ensure that pollution "hot spots" will not result from trades. The fundamental principles for nutrient trading in the Chesapeake Bay follow:

Fundamental Principle #1

Trades must not produce water quality effects locally, downstream, or Baywide that

- violate water quality standards or criteria
- do not protect designated uses

or

- adversely impact living resources and habitat.

Fundamental Principle #2

Trading will be allowed only within each major Bay tributary (i.e., Susquehanna, Potomac, Rappahannock, York, James, Patuxent, Maryland Western Shore, Virginia Western Shore, Maryland Eastern Shore, Virginia Eastern Shore) among all signatory states and nonsignatory states if they adopt the appropriate allowance and are consistent with the Chesapeake Bay Program's nutrient trading guidelines and state tributary strategies.

Fundamental Principle #3

The nutrient trading program must be consistent with Federal, state, and local laws and regulations, be flexible enough to adapt to future changes in these laws and regulations, and enable participation of all potential sources as determined by the market place.

Fundamental Principle #4

The nutrient trading program must be consistent with the Chesapeake Bay Program's nutrient reduction goals and state tributary strategies.

Fundamental Principle #5

Each trade must result in a net reduction in nutrient loadings or contribute to maintenance of a tributary nutrient cap. Net reduction in loadings or maintenance of a cap shall be

calculated based upon the estimated tributary loadings at a point in time determined by the state.

Fundamental Principle #6
Sources should implement nutrient reduction actions to achieve the 40% reduction goal, as well as the goals adopted for the tributaries south of the Potomac River, prior to pursuing a nutrient trading option.

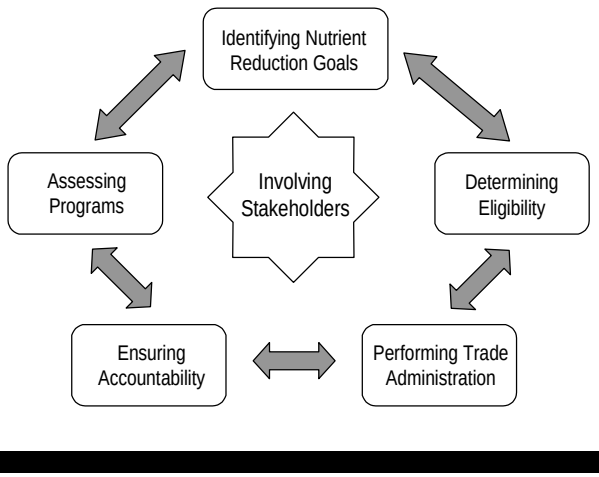
Fundamental Principle #7
Traders must be in substantial compliance with all local, state, and Federal environmental laws, regulations, and programs.

Fundamental Principle #8
The involvement of a diverse group of stakeholders must be sought in the design and implementation of state trading programs and related public education initiatives.

3.4 The Six Elements of the Nutrient Trading Program

Nutrient trading for the Chesapeake Bay Program can be envisioned as a six-part model containing distinct activities, events, and roles/responsibilities. Exhibit 3.3 illustrates the major elements of the framework and the relative relationship among the elements. The arrows in the diagram indicate that the trading program is dynamic and iterative. The length of time to cycle through a trade is yet to be determined. Sections 4.0 through 9.0 describe in detail the Negotiation Team's recommended guidelines associated with each element.

Exhibit 3.3 Nutrient Trading Concept



- ***Identifying Nutrient Reduction Goals***—The bay-wide goals established by the Chesapeake Bay Program for nutrient reduction or individual tributary specific goals. In the context of a trading program, these goals will correspond to and be congruent with appropriate allowances associated with tributary strategies.

- ***Determining Eligibility***—Activities to determine the number and types of credits that may be traded. Eligibility identifies the forms of nutrients that may be traded and

provides guidelines on what entities can participate. Potential trading entities may include point and nonpoint sources that meet certain minimum qualifications (e.g., be in substantial compliance with local, state, and Federal environmental regulations and programs).

- ***Performing Trade Administration***—Identifies roles and responsibilities within the trading framework. Specific activities for the Chesapeake Bay Program and states are defined. Also, this element addresses the need for a central coordinating office and application of trade ratios.

- ***Ensuring Accountability***—Post-trade monitoring and assessment of the effectiveness of the trade, including but not limited to, enforcement of the terms and conditions of a trade, provisions for extraordinary agreements, and recording updates to the trade. Issues of default and/or expiration of credits would be monitored and managed based on the terms and conditions established prior to the trade. Monitoring of local water quality conditions also is addressed.
- ***Assessing Progress***—Tributary and Baywide assessment of the effectiveness of the trading program outcomes, especially in terms of the nutrient reduction goals for individual traders, basins, and subbasins. This also includes the type of trade agreement and tracking credits bought and sold to make sure overall Chesapeake Bay basin goals are met. Issues of equity and efficiency would also be analyzed and summarized.
- ***Involving Stakeholders***—A set of activities and opportunities for any interested party to observe the trading program, monitor nonproprietary information about the trading program operation and accomplishments, and offer comments for improvement.

4.0 Guidelines for Identifying Nutrient Reduction Goals

Trading to Achieve or Maintain the Chesapeake Bay Nutrient Cap

1. Trading should be allowed among "like" source types in order to achieve the 40% nutrient reduction goal. This means that point sources could trade with point sources, and nonpoint sources could trade with nonpoint sources, but point sources could not trade with nonpoint sources.

   Within several years after the implementation of a trading program, the states may reexamine the success or failure of trades to date in achieving the goal and, thereafter, determine if cross-source trading to achieve is appropriate.

   Once the 40% nutrient reduction goal is met, trades should be allowed within and across source types to maintain nutrient reduction goals or further reduce nutrient levels.

2. For trading to occur within a major Bay tributary, the nutrient trading program must incorporate (a) specific nutrient loading allocations established to provide water quality conditions necessary to protect living resources in the tributary and the Bay, (b) a baseline and a cap for nutrient loads for the tributary, and (c) allowances for point and nonpoint sources.

Every trading program must have a goal or cap that drives the trading process. The term "cap" also is generally used to describe the total load allocation of a pollutant that can be discharged to a water body. Caps can be Total Maximum Daily Loads (TMDLs) established pursuant to the Clean Water Act or they can be goals established pursuant to the Chesapeake Bay Program. Guideline #2 was added to reflect the new Chesapeake 2000 agreement, which states that these loading allocations will be established to provide water quality conditions necessary to protect living resources. Guideline #2 also acknowledges that allowances for point and nonpoint sources will need to be defined in order to successfully operate a trading program.

In the case of a water-based nutrient trading program, quantifying a cap on nutrient loads that may be released to a particular watershed or other geographic area serves as that goal. From this cap, specific allowances may be determined. Until new load allocations are set according to the Chesapeake 2000 agreement, the 40% Nutrient Reduction Goal, established by the Chesapeake Bay Program in 1987, will serve as the initial cap for a nutrient trading program in the Chesapeake Bay. Due, however, to improved science and evolving technologies and other related programs (e.g., Chesapeake 2000 or TMDLs or tighter reduction goals), this goal may change over time. A trading program must have the flexibility to adapt to changing goals.

The operating premise for many Chesapeake Bay Program activities is achievement of 40% reduction in nutrient loading from 1985 levels by the year 2000. This 40% reduction goal establishes an overall cap of nutrients that can be discharged into the Bay and is defined on a tributary-specific basis through the use of Tributary Strategies. The tributary load allocations provide a starting point for determining caps and source allowances for a nutrient trading program. These allowances based on nonregulatory Tributary Strategies will serve as the

primary operating premise for these nutrient trading guidelines unless superceded by new goals or regulatory requirements. Trading may be one option, along with other measures identified in the Tributary Strategies to improve water quality in the Bay and its tributaries, so that these waters may be removed from the impaired waters list (delisted) prior to the time frame when a Baywide tidal TMDL would need to be established.

The primary consideration in the implementation of any trading program is whether it will serve as a reliable tool for achieving nutrient reduction goals; therefore, a trading program must be designed to maximize the ability to do this. Guideline #1 makes a key distinction between trading to achieve the cap and trading to maintain the cap. Trading to achieve would allow similar source types to trade to meet their tributary strategy nutrient reduction load allocations. Trading to maintain would require that sources first meet their tributary strategy load allocations prior to participating in trades across source types (e.g., point to nonpoint source trading). Once met, these sources could then trade to maintain to stay within their tributary strategy load allocation. The Negotiation Team spent a considerable amount of time determining whether trades could occur to meet and/or maintain the cap and arrived at a consensus on the guideline presented above; however, the Negotiation Team also recognized that the jurisdictions are responsible for determining when the 40% goal has been met.

5.0 Guidelines for Determining Eligibility

Guidelines Applicable to All Source Categories

3. Total Nitrogen and/or Total Phosphorus are the forms of nutrients eligible for trading.
4. Eligibility consideration should be given to all potential point and nonpoint sources to the extent allowed under current local, state, and Federal programs.
5. A source may receive credits for reductions in both nitrogen and phosphorus through the operation of a facility or the implementation of a BMP that reduces both nutrients.
6. Entities that are not considered sources may purchase credits (e.g., for the purpose of banking credits or retirement).
7. Any source receiving state or Federal funds to achieve nutrient reductions through the development or installation of any nutrient reduction equipment, technology, or structural BMP cannot buy credits to achieve those reductions. If state or Federal funds are used to cost share nutrient controls that generate credits, only the portion of those credits not paid for by the state or Federal cost share are available for trading.

Additional Nonpoint Source Eligibility Guidelines

8. All farmers (sellers) must be following a state certified Nutrient Management Plan to be eligible to participate in trading.
9. All BMPs must meet NRCS standards and be part of a Conservation Plan.

Urban Eligibility Guidelines

10. All nonagricultural nonpoint source storm water systems governed by a state and/or Federal storm water permit(s) are eligible to generate measurable and certified credits for those reductions that exceed permit requirements. For those storm water systems not governed by permit, each must have comparable requirements (to permitted systems) prior to the generation of nutrient reduction credits.

One necessary component to any trading program is the determination of who will be eligible to trade. Clear eligibility requirements help to delineate the rights and responsibilities of trading partners and are essential to ensuring that the other guidelines, especially fundamental principles, are achieved. Eligibility is based in part on the program's overall nutrient reduction goals and its ability to enforce a particular type of trade and monitor for compliance. Eligibility must be broad enough to enable an adequate available number of trading partners, while ensuring that applicable water quality goals are met. Certain details can be included in a trading program to address issues of equity, trading ratios, minimum qualifications of a trader, past performance of classes of credits, and similar qualifications.

Eligibility consideration should be given to all potential sources (discrete point sources such as Publicly Owned Treatment Works [POTWs] and industries, urban diffuse sources, and agricultural nonpoint sources) to the extent allowed under current local, state, and Federal programs. Baywide, 25% of the nitrogen loading is attributable to point sources, while 59% is discharged by nonpoint sources. Given this, the Negotiation Team concluded that it is important to allow trading among point and nonpoint sources. Point source-point source, nonpoint source-nonpoint source, nonpoint source-point source, and point source-nonpoint source trades could,

with appropriate guidelines, be implemented in an effort to capture as much reduction potential as possible from all sources.

The Negotiation Team made an important distinction in Guideline 7 with regard to trading versus use of public funds to obtain reductions. It was agreed upon, by consensus, that any source receiving state or Federal funds to achieve nutrient reductions cannot use those reductions to generate credits for sale or to buy credits. An exception to this guideline, however, is for Federal facilities trading among or within other Federal facilities.

All sources are eligible to trade pursuant to various eligibility criteria per source type and class of trade. When determining eligibility guidelines, the Negotiation Team considered requirements for buyers and sellers of credits among the following categories of sources:

- Point source
- Agricultural nonpoint source
- Nonagricultural nonpoint source (e.g., urban diffuse sources).

Point Sources

The point source category for trading includes facilities that are regulated under the National Pollution Discharge Elimination System (NPDES) permitting program and discharge effluent from a discrete location (e.g., outfalls such as a pipe). For the most part, these sources include wastewater treatment plants and regulated industries. Because these sources tend to discharge nutrients from discrete outfalls, it is easier to monitor the level of nutrients being released, and, therefore, accounting of nutrient loads (credits) is more easily quantified and accurate.

Agricultural Nonpoint Sources

Agricultural nonpoint sources, on the other hand, are often more diffuse and difficult to measure. The Negotiation Team reached a consensus on a number of agricultural nonpoint source eligibility criteria. It was decided that all farmers must have a nutrient management plan in place that meets state standards to be eligible to participate in trading. Not all practices associated with this plan are capable of generating credits. Those that were built using government cost-share funds would not be eligible; instead, reductions in nutrients associated with cost-share funded practices would be applied toward achieving the state's 40% nutrient reduction goal. The Negotiation Team also felt that while some inequities may arise, BMPs installed prior to a state adopting a trading program would not be tradeable. Additional guidelines associated with

agricultural nonpoint source trading are outlined in 8 and 9 of the guidelines summary box at the beginning of this section.

Urban Diffuse Sources

Urban diffuse sources includes runoff from built (e.g., existing developments, city streets, parking lots) and nonbuilt (e.g., yards, parks) environments and areas under construction. Additionally, urban diffuse sources may encompass combined sewer overflows, also subject to Federal regulation. Some of this runoff makes its way directly to streams and other water bodies, and some is collected in storm sewer systems. Many jurisdictions have regulations in place for runoff collected by storm sewers (referred to as storm water). On a national level, many municipalities will be regulated under either the Phase I or Phase II NPDES Storm Water Program.

There are many possibilities for integrating nutrient trading into an urban diffuse source program. Clearly, it must be integrated with existing regulatory programs. Potential buyers from this category may be residential or commercial developers; sellers may be localities who are implementing large holding ponds or upgrading septic tanks.

6.0 Guidelines for Performing Trade Administration

Baywide Program Oversight

11. The Chesapeake Bay Program should have an opportunity to comment on state programs with respect to fundamental principles, consistency, interstate trades, and program effectiveness.

State-Level Program Oversight and Management

12. Each state will be responsible for program oversight and the applicable level of day-to-day program management. These functions should include the following:
    - Establishing policy direction
    - Certifying credits
    - Establishing guidance on eligible trades
    - Registering and tracking the generation of credits, including quantities retired for net water quality benefits
    - Monitoring compliance
    - Enforcing program requirements
    - Evaluating program performance.

Establishment of Central State Coordinating Office

13. A central trading coordinating office should be established within each state to track the administration of trades. The organization may be formed within an existing state government or formed from a conglomerate of state and local stakeholders.

Trade Ratios

14. Each trading program should address the following ratios:
    - Delivery ratios
    - Special needs ratios
    - Retirement ratios
    - Uncertainty ratios.

Trade Facilitation

15. Each trading program should address trade facilitation, including those activities that support the negotiation and recording of completed trade transactions. Specific activities and roles should be determined by the states.

Actual implementation of a trading program can be complex, involving many different roles and responsibilities by a range of entities. It is important to clearly define the administrative roles necessary to smooth implementation of the program. Trade administration also encompasses specific components of program operation—the mechanism(s) and agreement vehicles for implementing trades, duration of trading agreements, establishing credit prices, tracking trades, and program funding.

Establishment of a nutrient trading program involves the transfer of nutrient credits from one entity (seller) to another (buyer). In order to ensure that transactions occur smoothly, efficiently, and in a legally defensible manner, and to foster the long-term viability of a credible trading program, it is essential that administrative and organizational requirements, including responsible parties, are clearly defined. When establishing administrative requirements, it is important to

clearly identify the entities in charge of program oversight and day-to-day program management, actual trade facilitation, and other aspects of a trading program (e.g., public involvement, technical support). It is also important to define administrative components, such as the enforcement mechanism to be used to implement trades and the duration of a trading agreement. Trade administration options—including roles/responsibilities and program components—to be considered by states in the development of their nutrient trading programs are provided below. An overview of trading ratios, including options to be considered by the state, is presented in Appendix D. These ratios are a key component to administering a trading program.

Administrative Roles for Trade Administration

The Negotiation Team identified four primary and two ancillary functions that must be addressed in a trading program. These are program oversight, program management, stakeholder involvement, trade facilitation and tracking, technical support, and public education, respectively. The four primary functions are described below.

Baywide Program Oversight. While the Negotiation Team felt it important for each state to be responsible for its own oversight and management, the Team agreed that a Baywide program oversight body should be established to ensure consistency across state programs. This body would be composed of representatives from all pertinent stakeholder groups (state agencies, buyers and sellers, environmental interest groups, etc.). The Team identified the Chesapeake Bay Program as the best oversight entity.

State-Level Program Oversight and Management includes setting policy direction on eligible trades and program evaluation. It also includes management activities associated with credit certification, compliance monitoring, and enforcement. The Negotiation Team reached consensus on the need to have each state responsible for program oversight and management within its respective state.

Trade Facilitation and Tracking includes those activities that support the negotiation and recording of completed trade transactions. In general, this role includes brokering trades by providing information and participant matching. Specific activities may include the following:

- Helping to match buyers with sellers
- Identifying, verifying, and prioritizing trading partners

- Assisting potential trading partners in understanding the regulatory and legal framework of the program and providing advice on how participating in the program may or may not serve their interests
- Helping potential trading partners to negotiate and prepare trade agreements
- Registering and tracking the generation and use of credits, including quantities retired for net water quality benefits
- Keeping a Web site of information on current trading prices, available credits, interested buyers and sellers, and other information to facilitate the union of buyers and sellers.

Appendix E provides examples of forms that could be used for trade tracking.

Program Components of Trade Administration

Several components of program operation also are encapsulated under trade administration. These components identify the appropriate mechanism(s) for implementing trades, the timing and duration of a trading agreement, the approach for establishing the price of credits, and techniques to fund program implementation. Discussions from the Negotiation Team's deliberations in these areas are defined below.

- ***Mechanism(s) for Implementing Trades***—Negotiated trades will be recorded in an enforceable document that serves as a contract between buyer and seller. The details of that document should be left flexible and will be determined by individual states according to their specific trading policies.

- ***Duration of Trading Agreement***—The duration of a contractual agreement should be contingent upon the type of trade. Using the framework of the Clean Water Act, the maximum duration of a trading contract will be 5 years, corresponding to the length of a NPDES permit. Trade contracts involving nonpoint sources should be appropriately shorter to reflect their higher risk, unless a longer duration can be justified.

- ***Establishing Credit Prices***—The prices of credits typically are established by the market's supply and demand curves. Appropriate trade administration design should allow sufficient demand to be created for credits. The trading program should follow as simple and flexible a design as possible to reduce transaction costs, while still ensuring that water quality objectives are protected. Grant programs should be used in such a way as to incentivize nutrient trading; for example, larger grants could be offered early in a 10-year program.

- ***Program Funding***—To launch the program would require state support at the outset. In particular, the state should investigate incentives for participation, such as grant programs (e.g., larger grant offerings earlier in the program). Eventually, the program could be funded through participant fees.

7.0 Guidelines for Ensuring Accountability

Guidelines for Assessing Performance

Point Sources

16. Self monitoring and reporting of nutrient reduction should be required for participants in the trading program.

Nonpoint Sources

17. All nonpoint source controls should be inspected to ensure the control is properly sited, the materials and plans satisfy established quality specifications, and the installation job meets performance standards.
18. All nonpoint source controls should undergo an annual on-site assessment by a qualified inspector to ensure proper functionality (e.g., look for signs of sedimentation and erosion to identify inefficient BMPs). In addition, the nonpoint source should allow right of entry by the state or its designated agent, and the states should use scheduled spot check inspections to supplement scheduled random inspections.

States

19. States will be responsible for performing, collecting, and analyzing ambient water quality monitoring and overall program assessment.
20. In addition to ambient water quality monitoring, states should include other types of data (e.g., weather patterns, slope, soil types, effluent monitoring data) to predict the effectiveness of trades, to assess whether trades are meeting and maintaining water quality standards, and whether traders are meeting applicable limits.

Guidelines for Account Balancing

Point Sources

21. Point sources will monitor and report on a monthly basis. A yearly accounting period should be used to assess the trade.
22. Point sources should have mechanisms in place to calculate the credits or portions of credits eligible for trading.

Nonpoint Sources

23. Annual account balancing periods should be used for nonpoint sources based upon seasonal sampling.
24. Nonpoint sources should have mechanisms in place to calculate the credits or portions of credits eligible for trading.

Guidelines for Enforcement and Compliance

General

25. The trading agreement will be enforceable by the state. After considering a variety of options, including general state permits, state regulations, and contracts, the Negotiation Team strongly recommends that trades should be governed by a state general permit or regulation issued under the state's water quality laws (versus Clean Water Act) and that the public will be provided opportunity for input prior to the execution of a trade. If a state elects to utilize a contract as a vehicle for enforcement, the contract development and enforcement processes must provide the same elements as if within the state's regulatory or general permit program, including public participation prior to the execution of a trade. Any NPDES permittee with a nutrient effluent permit limit desiring to trade should have the trade linked to its permit.

Point Sources

26. The state will maintain oversight of facility monitoring and reporting and will perform periodic compliance checks. The state will have full compliance and enforcement responsibilities, such as those performed under existing Clean Water Act programs and protocols.

Trading programs require methods and mechanisms that ensure all entities comply with their trading agreements. With established protocols for monitoring, reporting, and enforcement, participating entities can measure and communicate successes and challenges associated with a trading program. Several components comprise the accountability element in the nutrient trading framework:

- ***"Balancing the Account"***—A tracking process that summarizes the amount of nutrients actually discharged compared to the allowances held.

- ***Assessing Performance***—The synthesis of different types of monitoring (environmental quality, overall program performance, and facility-specific actions) to determine the efficacy of the program in meeting its goals.

- ***Ensuring Compliance and Assigning Responsibility***—Inspection and enforcement programs.

The Negotiation Team addressed each aspect of accountability, arriving at the following consensus-based guidelines. Three assumptions underpin these accountability guidelines. First, the threat of regulation exists. Second, other participation incentives, such as grant money, exist. Third, allowances have been determined and are known by all sources. Additional implementation options for trade accountability are presented in Appendix F.

Accounting Balancing

The Negotiation Team suggests that a monthly reporting and annual accounting be performed for point source trades. Recognizing the difficulties in collecting data and the potential for variation from natural factors such as weather, the Team recommended an annual accounting period for nonpoint sources—more frequent reporting is not required. Sampling for nonpoint sources, however, should be performed seasonally when runoff is most likely to occur.

Assessing Performance

Monitoring consists of ambient water quality monitoring, facility discharge monitoring and facility contractual compliance, proper BMP implementation and maintenance, and overall program assessment. The states should be the responsible parties for performing ambient water quality monitoring and overall program review and assessment. State efforts may be supplemented by referencing other monitoring networks, such as compliance monitoring by sources and citizen monitoring. Each point source facility is responsible for its own discharge monitoring and contractual compliance, reporting to the states on a monthly basis. The state will

maintain oversight of facility monitoring and will perform periodic compliance checks. The state will have full compliance and enforcement responsibilities as identified in the trading agreement.

Monthly monitoring for point sources is suggested to enable adequate tracking of nutrient reduction through trading and to provide sufficient time to take corrective action in the event that trading contracts are not being honored or anticipated results are not being achieved. It is further recommended that monitoring for nonpoint sources be performed on a seasonal, rather than annual, basis to better account for storm events and periods of wet weather. Account balancing for nonpoint sources would be on an annual basis.

Ensuring Compliance and Assigning Responsibility

In order for buyers and sellers to enter into a trading arrangement, some sort of agreement, such as a contract, must be written and signed by the two parties. This document will be enforceable by the state.

Under the contract with the buyer, a seller is responsible for providing nutrient reduction credits; however, the buyer is ultimately responsible for ensuring those credits are delivered so that the contract requirements can be achieved. In the event of seller default, a buyer can seek legal recourse against the seller. Additionally, a seller stands to loose its state certification, as well as may be required to repay the buyer for her/his investment or pay penalties per the terms and conditions spelled out under the contract.

Ultimately, a buyer is held accountable by the state to meet its allowance, through the purchase of credits or other reduction mechanisms. States will allow adequate time for a buyer to correct for noncompliance before enforcement penalties are levied. States also will provide information to buyers on alternative credit availability.

Additionally, the trading agreement must be enforceable by the state. The Negotiation Team favors use of a state general permit or regulation issued under the state's water quality laws. A general permit not only affords enforceability, it allows for public review.

In certain cases in which nutrient specific limits exist in NPDES permits, there must be a linkage between this permit and a general trading permit. The Negotiation Team believes this is certainly necessary in the cases in which the NPDES permittee is the buyer and desires to purchase credits in order to meet its nutrient limits (thereby possibly discharging above its permit requirements). The Negotiation Team further determined that there is room for discretion, however, when an NPDES permittee desires to sell credits (or discharge below its permit limit).

8.0 Guidelines for Assessing Progress

Monitoring Trades and Trading Impacts

27. States will perform ambient monitoring and modeling to assess the effect of trading programs in achieving or maintaining baywide (e.g., 40% reduction goal) and tributary specific nutrient reduction goals. These monitoring and modeling efforts should build upon existing efforts currently used by states and trading participants. Point sources involved in nutrient trading must monitor and report total nitrogen and total phosphorous discharges as applicable to the trade. Nonpoint source monitoring should be conducted to provide sufficient data to demonstrate the effectiveness of trading actions. If monitoring is not utilized, then nonpoint source pollutant loading reductions will be determined based upon data and analysis obtained from the Chesapeake Bay Program's Watershed Model. If the modeling approach is used, trading ratios must be applied to accommodate for uncertainty.

State Tracking Mechanisms

28. States must develop mechanisms to collect and track trading information that is compatible with existing mechanisms used by the Bay Program for assessing progress toward achieving and maintaining nutrient reduction goals (e.g., watershed model, BMP tracking system, environmental indicators, State of the Bay Report). Tributary specific information must be collected by the state and aggregated to demonstrate how trading supports the achievement and maintenance of nutrient reduction goals. Information requirements include the following:
    - Total annual load reduction of nitrogen and phosphorous
    - Total annual load reduction of nitrogen and phosphorous by type of trade (p-p, p-nps, nps-p, nps-nps)
    - Total annual load reduction of nitrogen and phosphorous by discharger type (point source, agricultural, and urban nonpoint sources)
    - Net loading reduction of nitrogen and/or phosphorous generated by trading partners
    - Comparison of pre-trading water quality conditions to post-trading water quality conditions
    - Total number of trades made
    - Total annual number of trades
    - Determination of whether cumulative effects of the trading program are contributing to achieving tributary strategy goals.

Reporting Baywide Progress

29. The Chesapeake Bay Program must provide a similar Baywide analysis (as outlined under the State Tracking Mechanisms guideline) based on the trading information it receives from the states.

Evaluating Accountability, Compliance, and Enforcement

30. States must track the actions of trading partners, compliance with trade agreements, and any enforcement action taken. Information requirements for each tributary watershed and the state include the following:
    - Total annual number of trading partners subject to periodic compliance checks
    - Total annual number of trading partners deemed to be out of compliance with existing regulatory requirements
    - Total annual number of trading partners deemed to be out of compliance with the terms of their trade agreement
    - Total annual number of trading partners that corrected noncompliance issues
    - Total annual number of trades subject to enforcement penalties.

Establishment of a Central Coordinating Office

31. The central coordinating office, as described under the Guidelines for Performing Trade Administration, will be responsible for the state's responsibilities contained in these Assessing Progress guidelines.

Additional Information to be Provided by Buyer

32. Buyers of credits must provide available information and reason(s) for trades, including the following:
    - Credit price
    - Timeframe of trade
    - Nutrient reduction (in lbs)
    - Existing cost savings estimates.

The goal of a trading program is its driving force, influencing all other elements of the program and determining the goal for each participating entity. Therefore, it is important to measure progress toward the overall goal to determine if the trading program is on track. Using the information collected through the accountability element, those responsible for administering the trading program and the sources participating in the program should be able to assess the effectiveness of the program.

Nutrient trading should realize the goals set by the program and lead to improved water quality. These guidelines recommend that a nutrient trading program establish performance indicators and assessment criteria. While eligibility and accountability address criteria for individual trades, this trading element on assessment and indicators seeks to measure the effectiveness of the overall trading program.

To assist in the process of certifying and tracking trades and obtaining the basic information needed to assess the progress of the program, it is recommended that certain standard forms be developed and used when implementing a trading agreement. The forms in Appendix E (Trade Tracking Forms) are designed after the Lower Boise River effluent trading program. They offer a concise template for the type of information that should be collected in order to effectively track, certify, and publicize trades. A Reduction Credit Certificate form should be completed by the **seller** as part of the individual trading agreement, and should be sent to a central office that collects this information. This form specifies the amount of pounds being traded, taking into consideration all trading ratios, and delineates the length of time that trade is valid. This form should be certified by a qualified official to ensure the reduction methods are properly implemented and estimates and/or calculations are correctly performed.

The **buyer** of a trade should complete a Trade Notification Form. This form would be sent to the central tracking office, as well as to the state regulatory authority, along with other state reporting requirements, such as an NPDES permit. The Notification Form identifies the seller and buyer and the pounds being sold and bought. Both buyer and seller sign this form.

These forms and the tracking results should be available to the public at all times.

It is recommended that costs be documented and reported for all trades. This is invaluable information for determining the overall effectiveness of a trading program. Thus, it is recommended that the reduction credit certificate form also include a place to declare the selling price of the credits being sold. Similarly, for the trade notification form, a place should be included to request information on the amount of money the buyer will be providing the seller, and their assessment of their nutrient reduction costs should they not engage in trading.

9.0 Guidelines for Involving Stakeholders

33. Each state should create or use existing citizens advisory committees to be part of the nutrient trading program within each state.

34. Each state may choose to create a demonstration program.

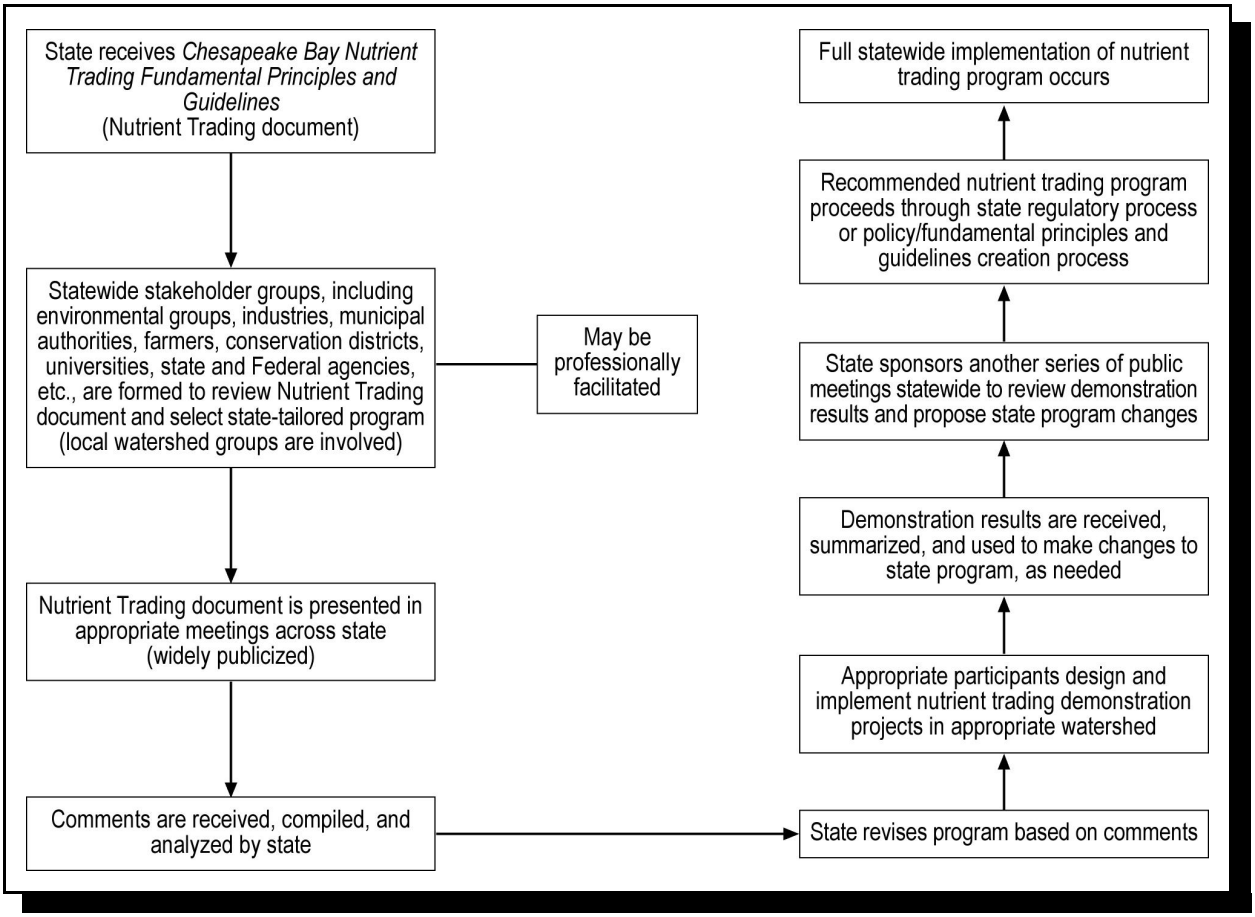
35. States should provide broad public notification of trades as they occur, including notification to local watershed groups.

This element of a trading program establishes two-way lines of communication and provides mechanisms for the public to participate in the program. To garner support for a trading program, members of the public need access to information and a mechanism for providing input and feedback. Early stakeholder involvement, and an effort to maintain involvement throughout the process, help to increase public confidence that water quality goals are being met in a cost-effective manner.

Enveloped in each element of the nutrient trading program is the need for stakeholder outreach and involvement. All interested parties will want to know that their interests are being met in the nutrient trading strategy and that the program is helping to achieve water quality goals. The TOWG's success in bringing together the major stakeholders together as a Nutrient Trading Negotiation Team demonstrates its commitment to stakeholder involvement. Citizen involvement is a subcomponent of this stakeholder outreach, as it will increase public understanding and support for final guidelines and future development of trading programs.

Exhibit 9.1 illustrates a suggested series of steps that states may take when developing and implementing a trading program.

Exhibit 9.1 Nutrient Trading Program Development: Stakeholder Process



10.0 Recommended Next Steps

Prior to development of a large watershed trading program, the Bay states may find that approaching trading in a series of phases will work best. For example, Maryland will have access to a study being performed to assess the nutrient trading market in this state. Pennsylvania is considering forming a nonprofit task force to develop state-specific trading guidelines based on this document, and Virginia is forming a stakeholder workgroup to evaluate market-based incentives for point sources based on this document. The results of these efforts will certainly provide valuable information on the viability of trading in the Bay watershed.

Appendices

Appendix A. Public Comments

This Appendix covers the following topics:

A.1: Public Meetings
A.2: Public Comments and Major Issues
A.3: Changes Made in Response to Public Comments
A.4: STAC's Comments and Major Issues

Public review of the Trading Guidelines consisted of 16 public meetings around the Bay watershed, solicitation and receipt of 118 written public comments, and also a review organized by the Bay Program's Scientific and Technical Advisory Committee (STAC). The Negotiation Team made changes in response to these comments where it considered changes appropriate. Changes not made in response to comments were generally because the Team believed that such comments related to details more appropriate for consideration by the individual jurisdictions in the development of their own programs, or because the comments were evenly balanced on both sides of a particular issue such that the Team's negotiated consensus reflects the best compromise on that issue. A summary of these comments is provided in a document entitled *Nutrient Trading in the Chesapeake Bay Watershed, Public Comments Summary*, January 2001.

A.1 Public Meetings

Sixteen public meetings were held during September and October 2000. The dates and locations are listed below. Generally attendance ranged from 3–30 attendees at each of the public meetings. Participants included stakeholders from a variety of disciplines, ranging from public citizens, environmental advocates, industry, and local governments. Discussions focused on educating the participants on the concept of trading more than the specifics of an individual trading program. Proceedings for each meeting have been compiled by each of the jurisdictions hosting the meetings. These proceedings, compiled into a document entitled *Nutrient Trading in the Chesapeake Bay Watershed: Public Meeting Proceedings*, January 2001, can be found on the Chesapeake Bay Program's Web site at www.Chesapeakebay.net.

Nutrient Trading Public Meeting Details

State	Meeting Location	Meeting Building	Meeting Dates/Times
Virginia	Bridgewater	Bridgewater Retirement Center	September 26, 10-12pm
	Manassas	Manassas Battlefield Holiday Inn	September 28, 2-4pm, 7-9pm
	Richmond	VA Power Office in Innsbrook, VA	October 3, 2-4pm,7-9pm
Pennsylvania	Williamsport	DEP North Central Office	September 28, 2-4pm, 7-9pm
	Harrisburg	DEP Rachel Carson Bldg	October 5, 2-4pm, 7-9pm
	Wilkes-Barre	DEP NE Office	September 26, 2-4pm, 7-9pm
Maryland	Laurel	WSSC Headquarters	September 26, 2-4pm,7-9pm
	Hagerstown	Hagerstown Community College	September 27, 7-9pm
	Eastern Shore	Salisbury State	September 29, 7-9pm
D.C.	D.C.	Martin Luther King Library	October 10, 6:30-8:30pm

A.2 Public Comments and Major Issues

One hundred and eighteen comment letters were received by the jurisdictions and the Chesapeake Bay Program collectively on the Draft Nutrient Trading Guidelines document. A summary of all of the comments, entitled *Nutrient Trading in the Chesapeake Bay Watershed, Public Comments Summary* can be obtained via the Chesapeake Bay Web site. This summary is an assimilation of the individual comment summaries prepared by each jurisdiction for the comments they received. Hard copies of the individual jurisdiction comment summaries are also available at the Chesapeake Bay Program, as well as hard copies of the actual comment letters.

The major issues presented by the comments are delineated below.

a) Guideline #1: trading to meet or maintain the reduction goals

Many believe that trading should not occur until after achievement of the 40% goal. On the other hand, many believe that this would unnecessarily restrict the market. Many believe that trading only between "like sources" will eliminate the most likely partnering of buyers and sellers.

b) Fundamental Principle #3:

Trading should have a defined cap within which to trade. Many felt that this should be accomplished via TMDLs. Many stated that trading should not occur until TMDLs are established.

c) Fundamental Principle #4

Many believe that trading should result in a net reduction, and not just remain as is.

d) Fundamental Principle #5: what does strive to do its part to meet the 40% goal

Many are confused about what this means.

e) Fundamental Principle #6

Many believe that trading within the major tributaries is too large an area for trades to ensure water quality. On the other hand, many felt that this would unduly restrict the market. Also, many were concerned that it is important to restrict the possibility of producing pollution hot spots.

f) Guideline 24: Permitting Trades

Many felt that trading should occur within the NPDES permit system, especially where local water quality is at issue. This is because general permits are not sufficiently transparent and do not include sufficient opportunities for public participation. Many felt that enforcement and accountability cannot be guaranteed if not in the NPDES permit system.

g) The section on ratios needs to be corrected, and/or clarified.

h) Monitoring

Water quality in streams or rivers with trades must be closely monitored. The guidance must require the establishment of a water quality monitoring program, which requires monitoring by the traders and the state. Many stated that the guidelines do not go into enough detail on this.

i) Trade Mechanism

Many comments were submitted regarding the trade mechanisms that would be in place for trading. Many wanted more information and felt the Guidance document is lacking here. The concept of individual trades versus a dynamic trading system was mentioned and several recommended providing guidance on this. A dynamic trading system, where available trades are generated and posted in a clearinghouse type fashion, available for sale on the open market was often mentioned as a preferable approach to limiting trades to individual relationships, which would bog down a trading program.

A.3 Changes Made in Response to Public Comments

The Nutrient Trading Negotiation met after the public comment period closed on October 27, 2000, to discuss the comments and to reach consensus on any changes resulting from the comments. The following changes were made to the November 29, 2000, draft document.

a) Additional language to be put into the guidelines:

For trading to occur within a major Bay tributary, the nutrient trading program must incorporate (a) specific nutrient loading allocations established to provide water quality conditions necessary to protect living resources in the tributary and the Bay, (b) a baseline and a cap for nutrient loads for the tributary, and (c) allowances for point and nonpoint sources.

b) Trading To Achieve or Maintain the Chesapeake Bay Nutrient Cap (Guideline #1)

Trading should be allowed among "like" source types in order to achieve the 40% nutrient reduction goal. This means that point sources could trade with point sources, and nonpoint sources could trade with nonpoint sources, but point sources could not trade with nonpoint sources.

Within several years after the implementation of a trading program the states may reexamine the success or failure of trades to date in achieving the goal and, thereafter, determine if cross source trading to achieve is appropriate.

Once the 40% nutrient reduction goal is met, trades should be allowed within and across source types to maintain nutrient reduction goals or further reduce nutrient levels.

Add to text: Allow states to make the determination (40% goal discussion)

c) Fundamental Principle #4

Change the fundamental principle from "Each trade must achieve no change in nutrient loadings or a net reduction in nutrient loadings" to "Each trade must result in a net reduction in nutrient loadings or contribute to maintenance of a tributary nutrient cap. Net reduction in loadings or maintenance of a cap shall be calculated based upon the estimated tributary loadings at a point in time determined by the state."

d) Fundamental Principle #5

Change this fundamental principle from "Every source should strive to do its part in reaching the 40% reduction goal prior to considering the nutrient trading option." to: "Sources should implement nutrient reduction actions to achieve the 40% reduction goal, as well as the goals adopted for the tributaries south of the Potomac River prior to pursuing a nutrient trading option."

e) Placement of Fundamental Principle #6

Move Fundamental Principle #6 on geographic scope to Fundamental Principle #2 so that the reader will see the direct connection between no impacts on local water quality to the geographic scope of a trading effort.

f) The Ratio Appendix

The Appendix on ratios was corrected to properly describe the use of ratios by other programs in the country

g) Guidelines for Enforcement and Compliance

24. Add "Any NPDES permittee with a nutrient effluent permit limit desiring to trade should have the trade linked to its permit."

Add in the text a statement about discretion as to whether an NPDES permittee wishing to SELL credits must have its NPDES permit linked to a trading agreement.

h) Guideline 22

Annual account balancing periods should be used for nonpoint sources based upon seasonal monitoring.

i) Guideline 24

Add a statement in the text about how trading between Federal facilities is an exception to guideline 24 regarding use of public funds to trade.

j) Change the title to " Nutrient Trading Fundamental Principles and Guidelines"

k) Add appendix about public meetings, comments, and responses.

l) Insert A, for page 14 under section 3.2: Geographic Scope

Trading may occur between states as long as the trade is within the major tributary boundaries, such as between Maryland and Virginia in the Potomac River basin. According to Fundamental Principle #6 below, however, trading would not be allowed between different basins in different states, such as between the Susquehanna and the Potomac River Basins.

m) Insert B, for page 28 under section 7.0: Ensuring Accountability

Remove second paragraph under "Assessing Performance" and replace with the following: "Monthly monitoring for point sources is suggested to enable adequate tracking of nutrient reduction through trading and to provide sufficient time to take corrective action in the event that trading contracts are not being honored or anticipated results are not being achieved. It is further recommended that monitoring for nonpoint sources be performed on a seasonal, rather than annual, basis, to better account for storm events and periods of wet weather."

n) Insert D on page 14 under section 3.3 Fundamental Principles, just after the second to last sentence of the first paragraph:

Note that the first fundamental principle essentially states that local water quality will not be impacted by trades. This is an overarching theme that any trading program must incorporate when considering trade location and nutrient credit exchanges. Implementation of this principle will ensure that pollution "hot spots" will not result from trades.

A.4 Comments Received by STAC

The Chesapeake Bay Program's STAC also provided comments on these trading guidelines. Not only was the Chair of STAC intricately involved in planning and organizing the Negotiation Team and their meetings, and providing technical expertise to the Team, but STAC also reviewed this document in addition to selecting three additional experts on trading in the United States to review this document and provide comment. The six people that performed this review follow:

Kurt Stephenson, Virginia Tech
Pat Norris, Michigan State University
Leon Danielson, North Carolina State University
Claire Schary, EPA with the Idaho Trading Program
Dave Batchelor, Michigan Department of Environmental Quality
Mark Tedesco, EPA with the Long Island Sound Program

Below is a summary of their comments. Hard copies of these comments may be obtained from the Chesapeake Bay Program.

a) Each reviewer made complimentary comments to begin the review.

It is a comprehensive document that is well written and should be easy for users to understand. The level of consensus that has been achieved is remarkable. It is a valuable resource to potential users. Great effort to get stakeholder involvement. Stakeholder involvement increases chances of program success. State flexibility allows states to select the approach that fits them best. Highly prescriptive trading programs have not proven to be very successful—these fundamental principles and guidelines strike a good balance in this regard.

b) Simple extension of command and control

Given the 34 guidelines, the system is a direct extension of the existing command and control system. Voluntary exchange can not exist. Simple extensions of command and control systems will not bring about the allowance markets that are the truly innovative solutions for water quality management.

c) Centralized regulatory agency versus decentralized allowance markets

This document does not provide information, guidelines, or discussion devoted to the characteristics needed for an allowance market to function. No distinction exists between centralized regulatory agency versus decentralized allowance markets. The trading framework embodied in the document provides a workable approach only for a highly managed program.

d) Allowance market development is missing

None of the eight fundamental principles deals with requirements for allowance market development. Property right conditions necessary for investment in aggressive pollution control activities are not provided for in this document.

e) Establishment of exchange commodity

The document leaves a lot to be desired on establishing the exchange commodity. A fundamental fact that is glossed over in the text is that the largest hurdles to overcome in establishing a market-like alternative is, in fact, establishing the exchange commodity—a limited number of enforceable discharge allowances. It is not clear from reading the document why a nitrogen source would want to purchase credits under the voluntary framework. At least one party to a trade must have a source specific, enforceable allocation. The treatment of trading credits versus adjusting allocations needs clarification. In many credit-trading programs, allocations remain the same but compliance is determined based on the discharge adjusted by the sale or purchase of credits. The definition of an allowance sounds like a TMDL-like definition of a waste load allocation for a point source, but it is unclear throughout the document whether the individual nonpoint sources will receive a TMDL-like load allocation.

f) Requirement severely restrict trading

The guidelines establish a number of requirements that severely restrict trading and the benefits trading offers. These factors will substantially decrease the number of trades and the economic and water quality benefits that could be achieved. Greater benefit at lower costs can be achieved through trading programs that establish a cap and let the market decide where the most cost-effective reductions can be found. The requirement that the buyer is liable for a seller's actions will diminish the willingness to trade. From an economic standpoint, it is not clear why point/ nonpoint trades are forbidden until after the 40% reduction is achieved. Because point sources have made reductions, their marginal cost are lower than less controlled nonpoint sources—large economic gains could be achieved with point/nonpoint trades. This document begs the question as to what incentive exists for a source to participate. The guidelines do not allow a source to trade to meet the limited specified by the allowance. If trading cannot be used to meet initial allowances, then how can it be used to meet the initial tributary load allocation or cap? If the public has the opportunity to comment prior to each trade, this would be an onerous and costly requirement that would most likely kill a trading program. The guidance requires states to certify credits but does not indicate how this will be done. It is not clear whether Fundamental Principles #4 and #5 allow sources to achieve a net 40% reduction through trading. These two principles will affect how targets and baselines are set and determine the performance of the program. The guidance removes the least cost options of reducing storm-water loading. The guidance creates "maximum extent practical" control technology requirements. The requirement for trading "like sources only" may create a barrier to municipal source participation. Restrictions on cross tributary trading severely restrict benefits from trading. A potentially big economic and environmental opportunity is being missed by not allowing trading between point and nonpoint sources at the outset. Explain the term prioritizing trade partners. Any prioritizing should be left to the private sector. The state should not be an enforcer of private contracts. The compliance design creates a tremendous administrative burden to the state by calling for a certification program for screening prospective buyers and sellers and then for certifying credits prior to trade approval.

g) Restrictions on use of cost-share funds

Restrictions on use of cost-share funds should be decided by the rules of the programs that provide those funds, not the trading programs. The document does not indicate how trading will be coordinated with nutrient management plans. Additional direction is needed on how to handle nonpoint sources, cost share monies, and nutrient management plans.

h) Compliance for nonpoint sources

It is unclear how compliance from nonpoint sources will be determined.

i) Working documents

The guide must be perceived as a "working document" and be revised after experience on actual cases.

Appendix B. Negotiation Team Membership

CHESAPEAKE BAY NUTRIENT TRADING NEGOTIATION TEAM INVITEES

#	Stakeholder Group	Principal Member	Alternate
1	US EPA, Region III	**Robert Koroncai**, EPA R3 Chief, WV & VA Branch Water Protection Division 215-814-5730 koroncai.robert@epa.gov	**Patricia Gleason**, EPA R3 Chief, DC & MD Branch Water Protection Division 215-814-5740 gleason.patricia.epa.gov
2	Chesapeake Bay Program	**Allison Wiedeman**, EPA Chesapeake Bay Program Office 410-267-5733 wiedeman.allison@epa.gov	**Jerry Griswold**, USDA/NRCS Chesapeake Bay Program Office 410-267-5754 griswold.jerry@epa.gov
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4	State of Maryland	**Virginia Kearney**, MDE Water Management Administration 410-631-3574 vkearney@mde.state.md.us	**Rich Eskin**, MDE Tech & Reg. Serv. Div. 410-631-3691 reskin@mde.state.md.us
5	State of Maryland	**Royden Powell**, MDA Asst. Secretary, Off.of Res.Consv. 410-841-5867 powellrn@state.md.us	**John Rhoderick**, MDA Administrator, Off. of Res. Consv. Operations 410-841-5865 rhoderjc@mda.state.md.us
6	Commonwealth of Pennsylvania	**Dave Bingaman**, PA Dept. of Agriculture Bur. of Plant Industry 717-772-5208 dbingaman@agric.state.pa.us	**Karl G. Brown**, PA State Conservation Comm. Exec. Secretary 717-787-8821 kbrown@agric.state.pa.us
7	Commonwealth of Pennsylvania	**Robert Yowell**, PA DEP Regional Director North Central Region 570-327-3695 ryowell@state.pa.us	**Stuart Gansell**, PA DEP Director Bureau of Watershed Conservation 717-783-7420 sgansell@state.pa.us
8	Commonwealth of Virginia	**Mark Bennett**, VA DCR 804-371-7485 mbennett@dcr.state.va.us	**Stu Wilson**, VA DCR 804-786-4382 swilson@dcr.state.va.us
9	Commonwealth of Virginia	**Alan Pollock**, VA Dept. of Env. Quality Chesapeake Bay Program Manager 804-698-4002 aepollock@deq.state.va.us	**John Kennedy**, VA Dept. of Env. Quality 804-698-4312 jmkennedy@deq.state.va.us
10	Chesapeake Bay Commission	**Ann Swanson**, CBC Director 410-263-3420 aswanson@ari.net	**Tom Beauduy**, CBC 717-232-1103 tbeauduy@srbc.net

#	Stakeholder Group	Principal Member	Alternate
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12	Local Watershed Interest	**John Flood**, Severn River Comm. 410-267-9692	**Patricia Jackson**, James River Association 804-730-2898 jra@i2020.net
13	Public Interest	**Helen Murphy**, Garden Club of VA 804-472-3094 htmurphy@sylvaninfo.net	**Jeane Packard**, Fairfax County Federation of Citizen Associations 703-978-4782 jeanp22032@aol.com
14	Local Government	**Paul Gunther**, Queen Anne's County Extension Director, MD. Coop. Ext. 410-758-0166 pg24@umail.umd.edu	**Robert Shaffer**, PA State Association of Township Supervisors Gannett Fleming Engineers & Planners 717-763-7211 rshaffer@gfnet.com
15	Municipal Point Source Interest	**Cy Jones**, MD Assoc. of Municipal Wastewater Agencies (MAMWA) 301-206-8831 cjones1@wssc.dst.md.us	**Bill Leary**, VAMWA Executive Director South Central Wastewater Authority 804-861-0111 wjlscwwa@erols.com
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19	Storm Water Interest	**Barbara Moore**, Virginia Municipal League Director Land Use & Env. Serv. 804-649-8471 barbmoore@att.net	**Larry Gavan**, City of Alexandria, Transportation & Environmental Services 703-519-3400 (x188) larry.gavan@ci.alexandria.va.us

Appendix C. Key Definitions

Accounting	Method of recording outcomes of monitoring. The accounting period can be monthly or yearly or other frequency. Regardless of the period, success of a trade will be documented, generally in pounds per year or other unit measurement.
Allowance	The allowed nutrient load a source may discharge.
Banking	Banking is a system where credits are stored for future use or sale (trade). These banked credits can be used at a future time when the discharger needs them, can be traded, or can be retired. Banking systems can be centrally arranged by a banking entity thereby creating a market place in which credit buyers and sellers can locate one another at a minimal transaction cost. The bank can be operated by a regulatory entity, or another public, private, or nonprofit organization.
Baseline	The numeric level of nutrient load at a particular point in time that serves to establish nutrient reduction goals and allowances.
Best Management Practices (BMPs)	BMPs refer to practices implemented by nonpoint sources designed to reduce discharges to surface water. Practices include runoff or erosion management systems at agricultural or construction sites and animal waste storage systems on farms.
BNR	BNR refers to Biological Nitrogen Removal, an advanced waste treatment process that lowers the amount of nitrogen released in a plant's effluent. Many states in the Chesapeake Bay watershed are promoting BNR as a technique to help meet tributary strategy goals.
Buyer	An entity that purchases nutrient credits.
Cap	The total nutrient load that is allowed to be discharged into a given waterbody. The cap is the baseline minus the amount of load reduction needed to meet the goal. The cap is equal to, or greater than, the sum of the allowances.
Credits	The amount of nutrient load reduced below the allowance.
Nutrient Management Plan	A comprehensive plan to manage the amount, placement, timing, and application of animal waste, fertilizer, sludge, or other nutrients.
Monitoring Period	Frequency of assessing nutrient reduction through performance inspections.
Nutrient Trading	The transfer of nutrient reduction credits, specifically those for nitrogen and phosphorous.

An open trading system allows regulated sources to modify their permits to reflect an exchange of pollution control requirements. In an open system, discharge limitations are imposed on individual sources and effluent allowances are only created when a source discharges less than the amount allowed under a permit. Open trading systems are common in the air emission trading program (adapted from Water Science Reporter. Effluent Allowance Trading: A New Approach to Watershed Management. National Institutes for Water Resources, 1996). Open trading is a system that refers to a situation in which there is no pollutant load cap on a water body.

A partially closed trading system sets a limitation or "cap" on nutrient loading for a geographical area and for a specified group of sources. The system allocates nutrient loading control responsibility to individual group members in the form of allowances. After allowances are distributed, sources can trade as long as total nutrient loading within the system does not exceed the pollution cap (adapted from *Water Science Reporter*. "Effluent Allowance Trading: A New Approach to Watershed Management." National Institutes for Water Resources, 1996). Partially closed systems are where discharge allowances are assigned to some, but not all, of the sources.

A fully closed trading system amplifies the partially closed trading concept and applies it to all nutrient load sources in a given watershed (adapted from *Water Science Reporter*. "Effluent Allowance Trading: A New Approach to Watershed Management." National Institutes for Water Resources, 1996). Fully closed systems are where discharge allowances are assigned to all of the sources.

Offset The term "offsets" will be used to specifically refer to reductions a new or expanding (or otherwise unaccounted for) source must accomplish prior to being allowed to operate in an impaired water body. Offsets will refer to the means in general of accomplishing pollution reduction, which could include trading or other efforts, such as technology reductions, alternative offsite land use conversions, etc.

Retiring Credits Credits can be retired, or taken out of, the market. For example, states, other administrative units, environmental groups, or speculative investors could purchase credits from a market, thereby reducing the amount of allowances that could be discharged into a body of water.

Seller An entity that offers nutrient credits for sale.

Soil Conservation and Water Quality Plan A comprehensive plan addressing natural resource management on farmlands directed toward the control of erosion and sediment loss and management of animal waste or agricultural chemicals to minimize their movement from agricultural land to surface waters.

Source	A nutrient source whether point, nonpoint, or third party. The Negotiation Team agreed to use the term source in place of discharger.
"T"	The goal of acceptable soil loss will be equal to "T", or tolerable soil loss. If this is not achievable the farmer, in consultation with the planner, can determine that site conditions and farming practices warrant an acceptable rating of "2T."
Trading Ratios	To account for the uncertainty regarding the effectiveness and monitoring of nonpoint source controls, trading ratios are applied in the cases in which nonpoint sources are involved. For example, a trading ratio of 2:1 means that for every pound increase in pollutant traded by a point source, there must be a corresponding two-pound trade from a nonpoint source.
Transaction Costs	Transaction costs are expenses for trading participants that may be required in order to establish a trade, including public and private participants and administrators. Transaction costs often include administrative, negotiation, legal, and documentation costs.
Water Quality Criteria	Water quality criteria indicate levels of water quality expected to render a body of water suitable for its designated use. Criteria are both numeric and narrative. Numeric criteria are scientifically derived ambient concentrations developed by EPA or states for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.
Water Quality Standards	Water quality standards refer to the law or regulation that designates the beneficial use or uses of a water body or a segment of a water body and the water quality criteria that is necessary to protect the use or uses of that particular water body. Water quality standards also contain an anti-degradation policy. The water quality standard serves a twofold purpose: (a) it establishes the water quality goals for a specific water body and (b) it is the basis for establishing water quality-based treatment controls and strategies beyond the technology-based levels of treatment required by sections 301(b) and 306 of the Clean Water Act, as amended by the Water Quality Act of 1987.
Watershed	A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Appendix D. Trading Ratios

CONTENTS: **Summary of Trading Ratios in Other Programs**
Examples of Other Trading Programs
Trading Ratios for the Chesapeake Bay
Example Credit Calculations

Summary of Trading Ratios in Other Programs

Many nutrient trading programs across the country apply several types of trading ratios to accommodate uncertainty, especially if nonpoint sources are participating, and to ensure protection of water quality. Typically, various ratios will account for the loss of a pollutant as it travels over land or in water, accommodate the uncertainty of reduction method (e.g., BMPs) efficiencies, or ensure a net water quality benefit. The use of ratios is essential in attaining the equivalency of credits between all permutations of trades (i.e., nonpoint-nonpoint, nonpoint-point, point-point). Although each program develops and adopts ratios that are best suited to its needs, the following are the most commonly used trading ratios:

- Delivery Ratios
- Uncertainty Ratios
- Water Quality Ratios
- Retirement Ratios.

It is important to note that these common ratio names may vary across programs. For example, one program may use the term "location ratio" instead of "delivery ratio." Although the terminology varies, the concepts are similar.

Delivery Ratios

Delivery ratios apply discount factors to compensate for a pollutant's travel over land or in water (or both) and may be applied to point, as well as, nonpoint sources. Delivery ratios generally account for attenuation (i.e., the rate at which nutrients are reduced through natural processes, such as hydrolysis, oxidation, and biodegradation, on their way through tributaries to the mainstem of the water body). The ratio varies depending on the location of the source from the mainstem. The general idea is that the greater the distance the pollutant has to travel, the greater the pollutant loss will be. This ratio would work to equalize a trade between a source high in the tributary and one near the mainstem. This ratio is also often termed a "location ratio."

Uncertainty Ratios

Point source nutrient discharges are relatively constant and easily quantified. By contrast, nonpoint source nutrient discharges are more uncertain and are readily influenced by storm events, seasonal variations, and site-specific physical and chemical characteristics. In addition, the BMPs applied to nonpoint sources generally provide a reduction potential that is an estimate rather than a measured value. As an example, Table D.1 shows the percentage of nitrogen and phosphorus typically removed by a number of nonpoint controls. Note the wide ranges reported, especially for nitrogen.

Table D.1 Nutrient Removal Efficiencies of Nonpoint BMPs

BMP	% Nitrogen Removed	% Phosphorous Removed
Urban storm water management	25–32	20–64
Pasture	20	14
Animal waste management – Cattle, swine – Poultry	 80 14	 80 14
Cover crops	34–51	10–20
Forested buffer	48–65	10–20
Grassed buffer	35–50	53

Source: Chesapeake Bay Watershed Model Application and Calculation of Nutrient and Sediment Loadings. Appendix H. August 1998.

To accommodate for this range of potential efficiencies, most trading programs attempt to address nonpoint reduction uncertainties by assigning a rate greater than 1:1 (i.e., requiring that more than one nonpoint credit be traded for one point source credit). As Table D.2 shows, the most popular rate used is 2 nonpoint credits for 1 point source credit (2:1). The U.S. EPA's Draft Framework for Watershed-Based Training (U.S. EPA, 1996b) cautions against using ratios that are too stringent and those that eliminate the economic benefits of trading.

Table D.2 Uncertainty Ratios Established by Other Programs

Program	Ratio	Program	Ratio
Tar Pamlico Basin	2 to 3:1	Rahr Malting Co.	2:1
Lake Dillon	2:1	Bear Creek	1:1 (PS/PS)
Chatfield Basin	2:1	Cherry Creek Basin	1.2 to 3:1
Kalamazoo	2:1	Red Cedar River	2:1

Water Quality Ratios

Water quality ratios may be included to account for the effect a source has on local water quality, or to relate the relative impact of pollutant reductions in any given watershed segment (e.g., tributary) to mainstem water quality goals, such as indicators of dissolved oxygen and living resources. Water quality ratios would account for situations, including nonattainment areas or sensitive areas such as wetlands, lakes, or wildlife sanctuaries, that may require additional water quality considerations. The increase in loads in such areas could have a greater impact than in less sensitive areas. In such cases, sources could have their reductions discounted by a factor (e.g., 10%) to achieve greater water quality protection. The water quality ratio and the delivery ratio are similar in that both involve location, but a delivery ratio addresses attenuation and considers source location relative to the distance from the water body of concern. A water quality ratio addresses location relative to special conditions in the receiving water; if needed, it may exist in addition to delivery ratios.

Retirement Ratios

A certain percentage of an available credit may be retired (i.e., excluded) from trading in order to increase the potential for a water quality benefit or to provide a margin of environmental safety (similar to an uncertainty ratio) for the overall trading program. Some programs require, for example, that 10% of the available credits for sale be taken off the market before any trades are negotiated. When evaluating the potential use of retirement ratios, it is important to also consider issues of cost, equity, and future economic growth. Options for retirement ratios include the following (McCatty, 1999):

- Requiring that a portion (e.g., 10%) of all credits traded by both point and nonpoint sources is contributed to the state. This is a fairly equitable approach, and, if the percentage is small, should not impose too onerous a cost on participants.

- Requiring that BMP credits expire at the end of the rated life of the installation. This is a reasonable requirement; however, difficulties may arise in multiple BMPs installed over an extended period of time and in the case of BMPs functioning efficiently beyond their rated lifespans.

- Requiring that all credits be retired at the end of 5 years. This is the approach taken in the Michigan program. It establishes a level playing field for all participants. In addition, the duration is sufficiently long enough for planning and assessment purposes.

- State agencies, citizen groups, or environmental nonprofits may purchase credits with the express purpose of immediately retiring them. Such action may be warranted in locations or periods of worsening water quality. It is, however, a costly option for all concerned and, by removing credits from the market place, may serve to dampen the market for trading and restrictive growth.

- Entities that cease to operate may be required to retire all or a portion of their credits. This policy may be pursued in areas in which growth is being discouraged for environmental reasons.

- Credits may be retired as part of penalties imposed on entities that continue to violate their terms of trade for an extended period of time (e.g., over two years).

Examples of Other Trading Programs

The following is a brief discussion of methods used by seven nutrient trading programs to determine various trading ratios. The programs are Long Island Sound, Lower Boise River, Tar Pamlico Basin, Michigan State, Cherry Creek Basin, Southern Minnesota Beet Sugar Cooperative, and Rahr Malting Co.

Long Island Sound

The proposed Long Island Sound trading program developed trading ratios based on the discharge's effect on the water quality once it reaches the Sound. The ratios attempt to equalize

the impact on dissolved oxygen levels of nitrogen discharged in various areas of the Sound. The program focuses on point-point trades. The main components are as follows (McCatty, 1999):

- The watershed is divided into 11 management zones. Normalized exchange rates, in terms of dissolved oxygen improvements in the Sound, were developed for each zone.

- Zones with the greatest influence on dissolved oxygen levels are given an exchange rate of 1.0. Zones with lower impacts are given values less than 1.0.

- Attenuation factors that take into account nitrogen losses in its travel downstream to the Sound are assigned to several tiers within each management zone. This ensures that reductions reflect levels of nitrogen delivered to the Sound.

- The exchange rate is calculated by multiplying the zone exchange rate and the tier attenuation factor and is intended to equalize the value of nitrogen removal between the respective management zones. Zones close to the Sound are assumed to deliver 100% of their pollutants to the Sound and, therefore, are not adjusted for attenuation.

- The exchange rate within each zone is set at 1:1.

Lower Boise River

The Lower Boise River program also proposes geographically based exchange rates using three types of water transport ratios: river location ratios, drainage delivery ratios, and site location factors (Schary, 2000).

River location ratios address the geographic relationship between sources located directly on the Boise River and the river's mouth at Parma, which is where it joins the Snake River and is the TMDL's point of concern. The ratios were established using a mass balance model that accounts for river flow and phosphorous concentrations, factoring in inflow, outflow, and groundwater in this heavily altered river system. For a given source, the river location ratio is equal to the amount by which the phosphorous loading at Parma would increase (or decrease) if one pound more (or less) were discharged at that location.

Drainage delivery ratios account for transmission losses (e.g., uptake by vegetation, infiltration to groundwater, etc.) in a drain or tributary. They are calculated by subtracting from 100 the number of miles a source located on a drain or tributary is from the mouth of the drain, then dividing that number by 100.

Site location factors address the potential for diversion and reuse of water below the point of discharge to the drain or tributary. Taken together, drainage delivery ratios and site location factors reflect the portion of the reduction that will be realized at the confluence of the drain or tributary with the river. When the three factors are applied to an amount of reduction (measured or calculated in "local pounds") by multiplying the four numbers together, the result is a uniform unit of measurement termed "Parma Pounds." This creates a common unit for measuring increases and decreases at different locations and will ensure that their effects on water quality

offset each other. Trades are converted back into local pounds when they are reported on the Discharge Monitoring Report (DMR). The permit's effluent limit for phosphorous for the point source is also expressed in pounds.

An uncertainty discount is applied to nonpoint source reductions, but it should be noted that it is only applied to those reductions that are not measured, and for which an estimating calculation is made instead. "Calculated credits" are those for which the amount of marketable credits will be determined by a calculation because direct monitoring of reductions is technically infeasible or too costly. The uncertainty discount is a multiplier that will reduce the number of transferable credits generated by a calculated nonpoint source reduction to account for variability in the effectiveness of the practice. It is applied prior to the conversion of the "local pound" credit amount into "Parma Pounds," and the amount of the uncertainty discount will be specified along with the BMP's design, installation, and maintenance specifications in the BMP list being developed by local, state, and Federal agencies.

Tar Pamlico Basin

The Tar Pamlico Basin Association is composed of point sources that work cooperatively to meet nutrient caps set by the state. If the Association does not meet its goals, it must purchase offsets by paying a pre-set price per pound to the state's Agriculture Cost-share Program for nonpoint sources. In the Tar Pamlico program, point sources that are members of the Association purchase credits for $29.00 per kilogram of nutrient discharged above the Association's cap. This fee is paid into an agricultural BMP cost-share fund managed by the North Carolina Division of Soil and Water Conservation Service. Trading ratios are based on the nutrient reduction efficiencies of three categories of BMPs: (a) animal waste management, (b) cropland practices without water control structures, and (c) cropland practices with water control structures (McCatty, 1999).

Table D.3 summarizes the nutrient reduction efficiencies and trading ratios adopted by the North Carolina Department of Environmental Management based on the results of monitoring data, studies, and best professional judgment. In addition to the applicable trade ratio, a discount factor of 30% is applied to credits to account for in-stream losses to Washington (McCatty, 1999).

Table D.3 BMP Nutrient Removal Efficiencies and Ratios in the Tar Pamlico Program

BMP	% Nutrient Removal	NPS/PS Trading Ratio
Animal waste management systems	50	2:1
Crop management practices without water control structures	30	3:1
Crop management practices with water control structures	60	Not Provided

Michigan State

The statewide program proposed by the Michigan Department of Environmental Quality also uses trading ratios to address uncertainty and to provide a net water quality benefit, as well as

discount factors to address distance, directionality, toxicity, and equivalence. Credits, called discharge reduction credits (DRC), are determined by subtracting reduced discharge level (RDL) from the baseline (B): DRC = (B – RDL). This quantity, minus the water quality contribution, represents the actual quantity of credits available for trading. Baseline calculations for BMPs take into account pollutant-specific loading associated with existing land uses and management practices (McCatty, 1999).

Each point source is required to retire (or in this case, make a one-time contribution of) to the Department of Environmental Quality 10% of the credits traded to account for uncertainty and to provide a net water quality benefit. Nonpoint sources contribute 50% (i.e., a nonpoint source/ point source trade ratio of 2:1). To further safeguard water quality, the Michigan draft rules contain options for site-specific and trade-specific ratios and an additional 10% discounting for locations upstream of impoundments or other protected areas (McCatty, 1999).

Cherry Creek Basin

Exchange rates in the Cherry Creek program are established on a project-specific basis in the range of 1.3:1 to 3:1. The Cherry Creek Basin Authority assigns lower ratios to more established, stable projects, and higher ratios to those with greater technical or institutional uncertainties. Criteria for assigning exchange rates are based on institutional, variability, and best professional judgment factors, as follows (McCatty, 1999):

> *Institutional Factor:* This is an assessment of the reliability, stability, accountability, financial, administrative, and technical ability of the project owner or operator. Authority projects receive the highest Institutional Factor of 1.00.
>
> *Variability Factor:* Calculated by dividing overall annual average phosphorus removal by the 95^{th} percentile of the dataset of monitoring data.
>
> *Best Professional Judgment Factor:* Accounts for scientific uncertainties and is based on (a) data limitations and assumptions, (b) level of establishment of the project, (c) project location, and (d) timing of pollutant reductions. For example, a factor of 1.0 is assigned to projects close to the Cherry Creek reservoir, which are well established and fully operational and have several years of comprehensive monitoring data. Others not so well established and documented receive a discount factor less than 1.0.
>
> *The exchange rate* (E) for each project is obtained by multiplying Institutional Factor (IF) by Variability Factor (VF) by Best Professional Judgment Factor (BPJ): $E = IF \times VF \times BPJ$.
>
> The Discharge Credits or pounds of phosphorus available for trading = quantified phosphorus removal × exchange rate.

Southern Minnesota Beet Sugar Cooperative

Southern Minnesota Beet Sugar Cooperative uses an exchange rate of 2.6 for its nonpoint trading, determined as follows (McCatty, 1999):

+ 1.0 = base 1:1 trading ratio
+ 0.6 = engineering safety factor reflecting potential site-site variations
+ 1.0 = net reduction factor to achieve load reductions that improve water quality.
2.6

Its NPDES permit contains procedures for calculating phosphorus reductions from each of the approved BMPs using Universal Soil Loss Equations or Revised Universal Soil Loss Equations, sediment delivery tables, and nutrient enrichment tables. The Natural Resources Conservation Service and the local Soil and Water Conservation District determine the Revised Universal Soil Loss Equation coefficients on a site-by-site basis. The list of approved BMPs comprises the following (McCatty, 1999):

- Soil erosion BMPs
- Cattle exclusion
- Rotational grazing with cattle exclusion
- Critical area set aside
- Constructed wetland treatment systems
- Alternate surface tile inlet
- Cover cropping.

Rahr Malting Co.

The Rahr Malting NPDES permit includes procedures, similar to those of Southern Minnesota Beet's, for calculating estimates of pollutant reduction for livestock exclusion, soil erosion BMPs, rotational grazing with livestock exclusion, critical area set-asides, and wetland treatment systems. An overall safety factor of 2 is built into the estimates, effectively a 2:1 ratio. The program defines one credit as equivalent to 1 pound of CBOD5 discharged per day. Table D.4 gives equivalency rates for the various pollutants (McCatty, 1999).

Table D.4 Rahr Malting Co., Pollutant Equivalency Rates

Trade Parameter	Measured Value/Day	Metro Reach BMP CBOD5 Credit	Upstream BMP CBOD5 Credit
Phosphorus	1 pound	8 units	8 units
CBOD5	1 pound	1 unit	Not Provided
Nitrogen	1 pound	4 units	1 unit
Sediment	1 ton	0.5 units	0.5 units

The phosphorus to CBOD5 exchange rate is 1:8 and CBOD5 to nitrogen is 1:4. This means that the discharger is allowed to release 8 pounds of CBOD5 for every pound of phosphorus removed by BMPs and 4 pounds of CBOD5 for every pound of nitrogen removed (net of 50% safety factor) for the life of the BMP.

The Rahr Malting exchange rate is, therefore, a combination of a 2:1 ratio to account for BMP uncertainties, and ratios ranging from 1:8 to 1:1 to equate the various pollutants with CBOD5 (McCatty, 1999).

Trading Ratios for the Chesapeake Bay

The Negotiation Team determined that the following ratios should be considered when developing a trading program in the Chesapeake Bay watershed:

- Delivery Ratios
- Uncertainty Ratios
- Special Needs Ratios *(Note: the Negotiation Team opted to use the term "special needs" in place of "water quality"; they are referring to the same ideas.)*
- Retirement Ratios.

The Chesapeake Bay Watershed Model is an application of the Hydrologic Simulation Program: Fortran model to the Chesapeake Bay watershed. It is one part of an integrated system of models designed to assess the impact of nutrient loads on the Bay system and includes (a) refined land use coverage, (b) loads for all land uses, (c) point source loads, and (d) load reductions expected from applied control measures (e.g., BMPs). This model is available to provide information for ratio determination for the Bay watershed as described below.

Delivery Ratios

Delivery ratios for the Chesapeake Bay, available from the Bay Program's Watershed model, account for attenuation during nutrient transport and are estimations of the quantity of nutrients from sources throughout the Bay that reach the Fall Line. Nutrients discharged below the Fall Line experience minimal delay before entering the Bay; hence, there is little need to discount for attenuation in these areas. Table D.5 presents example delivery factors for nitrogen and phosphorus above the Fall Line. These delivery ratios were derived from a draft watershed model run simulating year 2000 conditions. The factors may change with respect to different model scenarios, sometimes by as much as 50%. Thus, it is recommended that trading programs developed in the next few years use the delivery factors developed by the watershed model's final **2000 Progress Run** (available from the Bay Program Office). The delivery factors derived from the watershed model are determined for each of the approximately 100 model segments that the Bay watershed is divided into. Exhibit D.1 is a map of the model segments that can be correlated with the segment delivery factors in Table D.5.

Preston et al., working on regression modeling of nutrient loading in the Bay watershed, report that areas of northeastern and southern Pennsylvania, parts of Maryland, and parts of the lower Eastern Shore have the highest delivered nitrogen loading to the Bay. Areas with high incremental yields and relatively low delivered yield include the New York part of the watershed and parts of central Maryland and western Virginia. Highest delivered yields are areas that drain directly to large streams or are areas of high incremental loading close to the Bay.

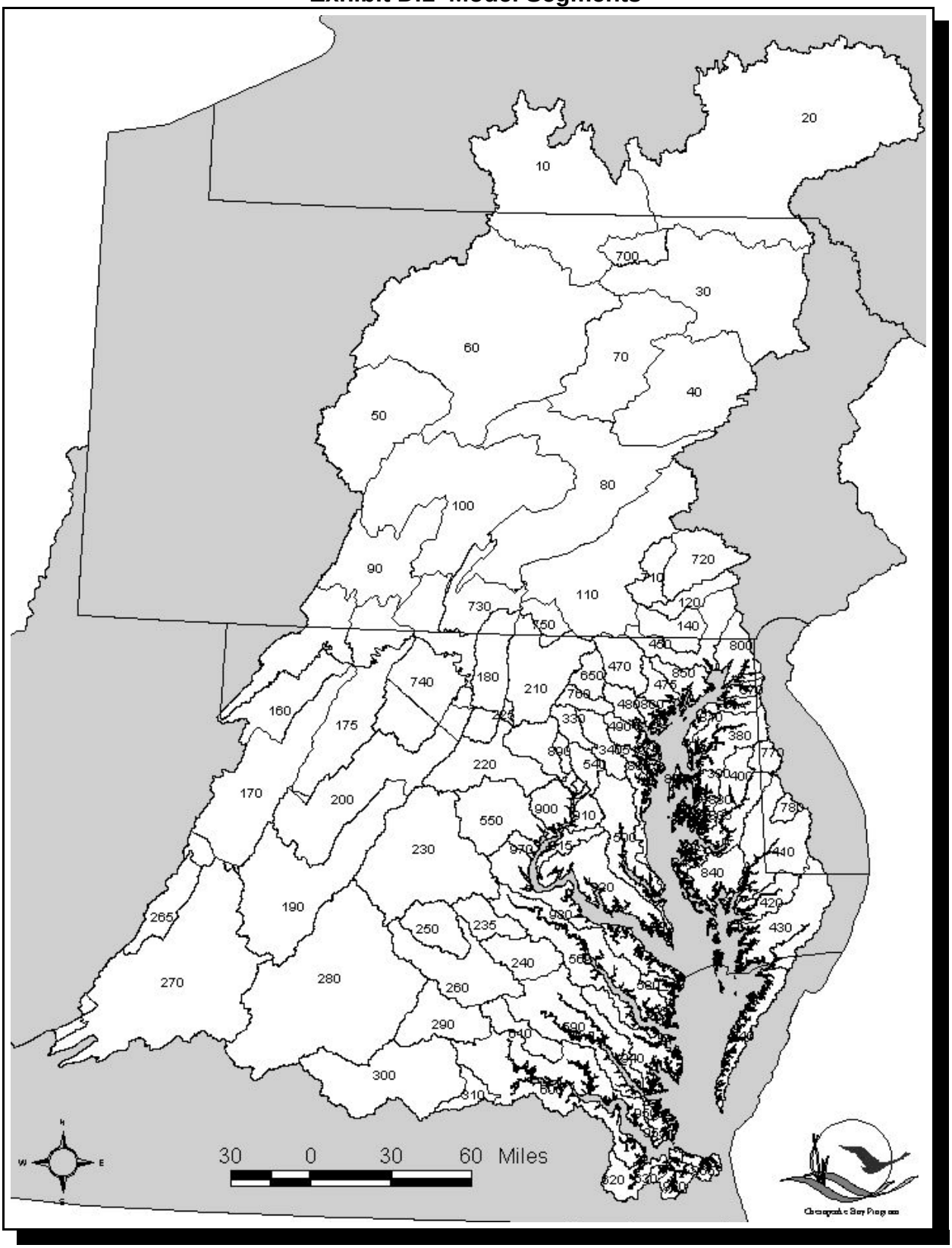
Another source of delivery ratios is the U.S. Geological Service's SPARROW model, which has a finer resolution than the Bay Watershed model. This model divides the Bay watershed into approximately 1,400 model segments. Delivery ratios were derived for each segment in a similar way to the Bay watershed model.

Table D.5 Delivery Factors from the Watershed Model Draft Progress 2000 Scenario

Nutrient Delivery Factors for 2000 Scenario				
TN Factor	Segment		TP Factor	Segment
0	650		0	650
0.026	250		0.4079	120
0.0833	265		0.4079	720
0.1593	330		0.4079	710
0.2163	190		0.4079	700
0.2812	270		0.4079	140
0.3134	300		0.4079	110
0.3511	235		0.4079	100
0.4959	10		0.4079	80
0.5056	240		0.4079	70
0.5148	200		0.4079	20
0.5321	20		0.4079	60
0.5348	160		0.4079	30
0.5438	170		0.4079	90
0.5445	750		0.4079	40
0.5805	260		0.4079	10
0.5843	310		0.4079	50
0.5872	230		0.4178	240
0.6002	280		0.4178	235
0.6283	730		0.4741	300
0.6443	50		0.4741	310
0.6539	210		0.484	260
0.6708	175		0.484	250
0.6822	770		0.566	730
0.7114	700		0.566	750
0.7168	740		0.566	160
0.7396	30		0.566	220
0.7456	90		0.566	210
0.7568	100		0.566	200
0.7782	60		0.566	190
0.7948	290		0.566	180
0.8036	180		0.566	740
0.8082	720		0.566	170
0.8321	220		0.566	175
0.8483	40		0.6905	770
0.8577	760		0.731	340
0.8622	340		0.731	330
0.8959	780		0.8706	780
0.8976	70		0.9381	265
0.9637	110		0.9381	290
0.9766	710		0.9381	270
0.9838	120		0.9381	280
0.9867	80		0.9438	230
1	490		0.9635	760

Nutrient Delivery Factors for 2000 Scenario				
TN Factor	Segment		TP Factor	Segment
1	370		1	490
1	380		1	370
1	410		1	410
1	390		1	380
1	400		1	390
1	930		1	400
1	470		1	930
1	850		1	840
1	860		1	850
1	870		1	860
1	880		1	870
1	890		1	880
1	900		1	890
1	830		1	900
1	920		1	470
1	820		1	920
1	940		1	810
1	950		1	940
1	955		1	950
1	960		1	955
1	965		1	960
1	970		1	965
1	980		1	970
1	910		1	980
1	580		1	910
1	430		1	560
1	440		1	430
1	450		1	440
1	480		1	450
1	990		1	480
1	500		1	990
1	510		1	500
1	540		1	510
1	840		1	830
1	560		1	550
1	420		1	820
1	590		1	580
1	600		1	590
1	610		1	600
1	620		1	610
1	630		1	620
1	800		1	630
1	810		1	800
1	550		1	420
1.0321	140		1	540

Exhibit D.1 Model Segments



Uncertainty Ratios

Determinations of uncertainty are based primarily on the reliability and efficiency of nonpoint nutrient reduction controls. (Camacho [1992] defines efficiency as 1 – post BMP/pre-BMP × 100.) The Bay model uses 21 BMP designations for its assessments. For this discussion of uncertainty ratios, the designations are consolidated into 5 categories, and nutrient reductions are averaged within categories (see Table D.6).

The ranges given indicate the variations in nutrient reduction efficiencies and are an indicator of BMP reliability. Here the assumption is made that the larger the range, the greater the variability and need for discounting to compensate for the associated uncertainty. While it appears that uncertainty ratios in the range of 1.5 – 3 would be generally applicable in the Bay watershed, it may be necessary to conduct more thorough analyses prior to adopting actual uncertainty ratios.

Table D.6 Estimated Nutrient Reduction Efficiencies for Main BMP Categories

BMP Categories	% N Removed	% P Removed
Animal waste management system (cattle, swine)	80	80
Urban storm water	25–33	20–64
Resource protection	25–75	25–75
Non-structural cropland	4–20	8–40
Nutrient management plans (cover crops)	34–51	10–20

Source: Summarized from Chesapeake Bay Watershed Model Application and Calculation of Nutrient and Sediment Loadings. Appendix H. Table 2.2. August 1998.

Special Needs Ratios

The Negotiation Team also determined that a ratio should be considered to account for areas in which special factors (e.g., sensitive waters or areas needing living resources protection) are involved. This special needs ratio is essentially a water quality ratio in that it would account for local water quality situations that may require additional protection for a variety of reasons.

Retirement Ratios

Credits may be retired (i.e., removed from trading) to provide net water quality benefits. For example, a portion (say 10%) of all credits traded by both point and nonpoint sources may be required to be contributed to the state. There are issues of cost, equity, and future economic growth to be considered, however, when doing so. Some related retirement scenarios follow:

- Requiring that all credits be retired at the end of 5 years. This is the approach taken in the Michigan program. It establishes a level playing field for all participants. In addition, the duration is sufficiently long for planning and assessment purposes.
- State agencies, citizen groups, or environmental nonprofits may purchase credits with the express purpose of immediately retiring them.
- Entities that cease to operate may be required to retire all or a portion of their credits. This policy may be pursued in areas in which growth is being discouraged for environmental reasons.

Example Credit Calculations

The best source of data quantifying nonpoint loads is again the Bay watershed model. Camacho (1992) gives edge-of-stream loading factors for conventional tillage, conservation tillage, hayland, pasture, animal waste, forest, and urban areas for 63 watershed segments. The following example illustrates the use of loading factor, nutrient reduction efficiency, uncertainty ratio, and transport factor to quantify available BMP credits.

Example: (Note: this example assumes that the farmer meets all eligibility requirements before trading.) A farmer located in the Lower Potomac has 500 acres of conservation tillage and wishes to trade nitrogen. How many credits would the farmer have available for sale? For the answer, follow the steps outlined in Table D.7.

Need to know	Answer
Watershed segment	220
Loading factor	13.5 lbs. N/acre/year
Nutrient reduction efficiency	21.3%
Uncertainty ratio	3:1
Transport factor	0.8315

Table D.7 Procedure for Calculating Nutrient Credits from BMPs

Step 1	Determine watershed segment.	Segment 220
Step 2	Check nitrogen loading factor for conservation in this segment (Table D.8).	13.5 lbs. N/acre/yr
Step 3	Calculate total nitrogen load from 500 acres (500 × 13.5).	6,750 lbs N
Step 4	Check nutrient reduction efficiency for conservation tillage.	21.3%
Step 5	Calculate nutrient removed by conservation tillage (6,750 lbs × 21.3%).	1,438 lbs N/year
Step 6	Reduce by 3:1 uncertainty ratio for conservation tillage (1,438/3).	476 lbs N/year
Step 7	Look up transport factor for nitrogen from segment 220 (Table D.5).	0.8315
Step 8	Reduce by transport factor for segment 220 (476 × .8315).	**398 credits (lbs N/year) available for sale.***

*Note that additional discounting to reflect water quality impacts and benefits also may be applied.

Note that a location in neighboring segment 200, which has a loading factor of 22.2 lbs/acre/year and a transport factor of 0.5746, would have a similar amount of nitrogen credits (406 lbs) from 500 acres of conservation tillage.

The information in Table D.7 is for one BMP example. In reality, multiple BMPs are often implemented over an extended period of time as part of an integrated resource management system. Such a scenario makes it difficult to separate load reductions associated with each BMP. For trading purposes, it should be sufficient to group these BMPs together, calculate the nutrient reductions for each type, and sum reductions for the entire group. Monitoring over an extended period would serve to validate these estimates.

Table D.8 Nitrogen Loading Factors: Conventional Tillage, Conservation Tillage, and Hayland; Land Use Acreage and Edge of Stream Loading Factors (LF) in lbs/acre

	Conventional Tillage		Conservation Tillage		Hayland	
Segment	Acres	LF	Acres	LF	Acres	LF
10	100,723	20.1	10,869	16.7	226,565	10.8
20	160,951	19.0	10,943	16.7	401,085	11.0
30	78,620	18.8	14,797	18.0	240,216	12.1
40	126,240	21.6	54,651	17.7	63,556	11.0
50	37,257	33.2	9,509	32.7	54,900	17.7
60	66,122	31.1	43,988	29.1	134,578	17.1
70	62,800	25.9	44,435	24.3	62,979	15.3
80	144,248	24.9	133,753	21.2	149,693	7.9
90	24,395	23.4	29,316	20.0	71,198	8.8
100	91,758	21.4	62,717	18.1	148,417	7.6
110	173,581	31.7	200,603	24.0	152,836	11.2
120	104,846	23.4	85,976	19.4	70,578	7.7
140	27,034	20.2	37,578	15.8	20,404	7.5
160	17,350	24.6	11,180	17.2	57,926	6.1
170	7,080	23.4	2,998	18.7	37,911	11.1
175	13,174	245.0	11,118	18.5	41,362	10.1
180	84,971	23.1	168,939	19.3	199,500	5.3
190	21,425	33.9	49,723	28.2	116,083	8.5
200	22,470	28.3	32,018	22.2	88,901	7.3
210	38,588	23.2	127,498	18.9	97,542	6.0
220	8,121	17.6	69,422	13.5	71,578	5.4
230	25,054	15.2	37,390	11.0	121,214	10.3
235	7,131	20.5	5,094	16.0	8,852	9.4
240	4,081	17.3	18,703	13.3	2,816	7.4
250	9,007	25.8	5,830	20.5	14,837	10.1
260	17,381	22.0	28,427	16.7	28,076	9.3
265	335	22.3	738	17.9	10,845	8.9
270	8,075	31.9	37,671	24.2	162,192	11.6
280	25,308	23.0	29,341	17.8	147,753	10.4
290	11,562	23.3	14,252	17.4	21,120	8.4
300	33,120	24.2	37,019	18.4	52,912	8.4
310	8,054	23.0	2,600	18.2	217	7.7
330	2,225	17.4	10,233	14.5	4,845	5.2
340	4,956	18.5	8,806	14.5	5,352	4.8

Source: Excerpted from Camacho, R. 1992. Financial Cost Effectiveness of Point and Nonpoint Source Nutrient Reduction Technologies in the Chesapeake Bay Basin. ICPRB Report 92-4. December 1992. Table A-1.

Appendix E. Trade Tracking Forms

Chesapeake Bay Program Nutrient Trading Program

Trade Notification Form

TO BE COMPLETED BY THE BUYER

Name of Buyer	
Type of Facility or Operation	
Permit # (if applicable)	
Name of Authorized Representative of Buyer	
Phone Number	

TO BE COMPLETED BY THE SELLER

Name of Seller	
Type of Facility or Operation	
Permit # (if applicable)	
Name of Authorized Representative of Seller	
Phone Number	

TO BE COMPLETED BY EITHER PARTY

Parameter Being Traded	
Amount of Nitrogen or Phosphorus Traded (specify units)	
Sellers Reduction Credit Certificate #	
Dates the Trade Will Be in Effect	
Purchasing Price of the Trade (include all units)	
Costs of Nutrient Removal (in the same units as the purchase price) if a Trade Were Not Conducted	

I certify that the above information is accurate and truthful to the best of my knowledge and is in accord with the state's trading program.

Signature of Authorized Representative of Buyer: _____

Signature of Authorized Representative of Seller: _____

Reduction Credit Certificate Form

CERTIFICATE NUMBER: _____

Name of Seller Facility or Operation:

Address:

Phone #:

Location of Source Being Traded (water body and lat/long):

Parameter Being Traded (Nitrogen or Phosphorus):

Type of Source Being Traded:

Nutrient Reduction Being Applied:

Monitoring Method and Frequency:

Amount Available for Trading (Credits Generated) (specify units):

Selling Price of a Credit (specify units):

Show below the calculations used to determine the Credits Generated (identify all ratios applied):

Contact Name:

I certify that the information provided above is accurate and truthful to the best of my knowledge.

Signature of Authorized Representative of Seller:_____

Appendix F. Implementation Options for Trade Accountability

This appendix presents implementation options related to administrative roles and program components for trade administration. The Negotiation Team presents these options for consideration by states in the development of their trading programs.

Stakeholder Involvement Options

Responsible Entity	Option Description	Examples
Multi-Disciplinary Steering Committee or Authority	This entity would be a multidisciplinary authority comprising key stakeholders, such as state agencies, environmental interest groups, trading participants (buyers and sellers), and the public. It would be responsible for providing overall program guidance to the state; ensuring a representation of a diversity of views from program managers, program participants, and affected parties; and creating opportunities for public consultation.	Although this is most similar to the structure and role assignment identified by the Negotiation Team, no examples have been identified at this time. Most existing programs assign a steering committee or authority more administrative and program management responsibility.
State Agency	This would be a state entity currently responsible for Chesapeake Bay Program Activities.	Michigan's Surface Water Quality Division of Michigan's Department of Environmental Quality is responsible for both program management and program guidance, but collaborates with representatives from agriculture, municipal, industrial, environmental, private sector, and regulatory agencies for program guidance and stakeholder involvement.
Multi-Jurisdictional Management Authority	This type of authority would be composed of representatives from each of the local jurisdictions, as well as from regional, state, and Federal organizations involved in watershed protection. Because of its governmental nature, its role is expanded to include other administrative/program management responsibilities, such as the approval of project proposals, and monitoring.	The Cherry Creek Basin Authority is composed of two cities, four counties, and seven special districts, as well as seven ex-officio members of regional, state, and Federal organizations involved in watershed protection. It is responsible for creating the opportunity for public comments and consultations and providing liaisons with state agencies, in addition to other program management responsibilities.
Combination Government/ Participant Steering Committee	This entity would comprise both governmental representatives and program participants.	The Chatfield Basin Watershed Authority (Colorado) is composed of representatives from 10 point sources and 5 regional, state, and Federal organizations. This authority allocates wasteload among its members, reviews applications, monitors trades, and provides technical support.
Association of Program Participants	This method uses a narrower definition of stakeholder involvement to include only the source participants in a trading program.	North Carolina's Tar Pamlico Association is a nonprofit organization composed of 14 point sources responsible for allocating allowances among its members and ensuring its group load cap is met. This approach may not be appropriate for a program that allows both point source and nonpoint source trades with numerous diverse trading participants.

Trade Facilitation Options

Responsible Entity	Option Description	Examples
State	In most existing trading programs, trade facilitation is considered a state responsibility.	Michigan Department of Environmental Quality will create a trading registry that will be updated daily and readily accessible through the Internet. Useful for trading programs in which there is the potential for a significant number of participants.
Trading Partners	Any two or more sources that have entered into a trading agreement.	Trading partners of the Minnesota's Sugar Beet Co-op and Rahr Malting Co. trading programs take an active role in locating nonpoint source partners and negotiating the terms of trades. This hands-on approach is well suited for trading programs in which the likely number of participants is relatively few.
Independent Trade Brokers	Private sector companies, or other independent organizations, with the requisite financial, legal, technical, and negotiation skills act as inter-mediaries between a wiling buyer and willing seller to define the credit price and trades terms that are mutually acceptable to both parties and in accordance with all government regulations. A brokerage system could be set up as a periodic auction or an ongoing commodity exchange.	In addition to offering a registry of credits, the environmental brokerage service of Cantor Fitzgerald offers trading seminars, technology evaluations, market price indexes, and assessments for the air emissions trading program. The use of independent brokers avoids potential conflicts of interest that may arise when a regulatory agency is in charge of both trade facilitation and program oversight.
Electronic Commerce Brokerage Services	A subset of independent trade brokers are e-commerce services, whereby potential traders could conduct trades and access information on up-to-date credit prices, the market, technical assistance, etc. directly from an online brokerage service/clearinghouse. This option provides the potential for reduced transaction costs.	Cantor Fitzgerald (see above). GreenOnline.com™ uses the Internet to conduct environmental commerce on a global scale. It is an electronic marketplace for news, information, products, communications, materials, and services pertaining to environmental commerce.

Technical Assistance Options

Responsible Entity	Option Description	Examples
State	Program managers and staff from state government can provide information on available technologies for credit generation and procedures for obtaining credits. This option also could include an extension branch of a state university.	The North Carolina Department of Environmental Management as part of its program oversight role for the Tar Pamlico Program provides technical support by tracking nutrient tradeoffs relative to allocations and imposing individual point source nutrient limitations where localized water quality problems exist.
Steering Committee or Authority	(See description under Stakeholder Involvement options.)	A technical review committee of the Cherry Creek Basin Authority prepares and assesses technical proposals. The Chatfield Watershed Authority provides technical support to trades.
Independent Trade Brokers	Trade brokers can provide assistance in preparing contractual agreements and providing advice on legal and regulatory issues. They could also be a repository for the latest information on available technologies for credit generation.	Cantor Fitzgerald offers trading seminars and technology evaluations for the air emissions trading program.

Options for Program Components of Trade Administration

Program components for trade administration identify the appropriate mechanism(s) for implementing trades, the timing and duration of a trading agreement, the approach for establishing the price of credits, and program incentives/funding. The Negotiation Team agreed upon the general terms for implementing trades, the duration of a trading agreement, the establishment of credit prices, and program funding. The details of each of these program areas will need to be defined by each state at the time of program development. General options and examples of how other trading programs around the country have addressed these elements are provided below. (Note: Additional research is needed to complete examples.)

Duration of Trading Agreement Options

Option	Description
Five Years	The Negotiation Team felt the duration of a contractual agreement should be contingent on the type of trade. The Team also felt that the maximum duration of a trading contract should be 5 years, corresponding to the length of an NPDES permit according to the Clean Water Act. Trade contract involving nonpoint sources should be appropriately shorter to reflect their higher risk, unless a longer duration can be justified.
Uniform Duration	There is the option of having a uniform trade duration for all trades. This duration could be based upon the NPDES cycle. One advantage of this approach is that it allows for the integration of trade monitoring functions with other NPDES control requirements resulting in administrative savings. The principle disadvantage of this approach is that it imposes a regulatory cycle designed for point sources on nonpoint sources. This may disqualify the use of short-term nonpoint source BMPs from being used within the market.
Shorter Durations	In general shorter duration periods allow for the market to be more responsive to changes in both the cost of control technology and changes in land use. Shorter durations also allow regulators flexibility in addressing potential issues, such as emerging hot spots or problems of default. Regulators could wait until after the trade has expired before taking action. This would avoid the potentially costly process of renegotiating trades, and would help to foster confidence among trading program participants.
Longer Durations	On the other hand, longer trade duration periods contribute to market stability. They are more advantageous for long term financial planning of both buyers and sellers, and the transaction costs from trading are reduced as the frequency of having to trade is reduced.
Variable Durations Based on the Period Credits Are Needed	Assigning trading agreement durations to correspond to the length of time an individual buyer needs credit reductions could result in a more efficient allocation of credits and dynamic trading markets. There would be less likelihood of credit banking; however, administrative costs would likely increase and short durations may be difficult to monitor. Buyers who underestimate demand may experience difficulties securing credits on short notice, resulting in episodes of noncompliance and adverse water quality impacts.
Contingent on Type of Source Control	The duration of the trade can be contingent upon the type of source control being used to generate the credits. For example, in the Tar Pamlico program, structural BMPs are eligible to generate credits for 10 years, or longer as provided for in BMP contracts, while nonstructural BMPs have a credit life of 3 years.

Credit Pricing Options

Option	Description
Direct Negotiations	Many programs currently rely upon direct negotiations between buyers and sellers. Direct negotiations for each trade typically result in a per credit price that is unique to that trade. As mentioned earlier, direct negotiations can be cumbersome and inefficient for larger markets, and a credit auction may be more appropriate.
Auctions	There are numerous types of auctions that could be used. Uniform price auctions may be an appealing approach because they are viewed by many participants as being more equitable. In this type of auction, buyers and sellers submit bids and offers for credits, the auction is called, and a single credit price is then determined, which is used for all transactions.
Permitting Authority	State sets price of credits in reserve pool to sell to sellers in default. While the market would determine the initial credit price for credits exchanged between buyer and seller, the state may wish to set a higher price for credits in a reserve pool that will be sold to a seller who would otherwise default on his/her trade agreement with a buyer unless he/she purchases credits from the reserve pool. The additional funds generated through the sale of these reserve credits could be invested in BMP installments in potential "hot spot" areas. The Cherry Creek and Tar Pamlico programs offer examples of this special case of price setting.

Program Incentive Options

Option	Description
Program Simplicity	The Negotiation Team agreed that trade administration design should be simple (while protective) so that sufficient demand be created for credits and transaction costs minimized.
Grants	The Negotiation Team recommends that grant programs be used in such as way as to incentivize nutrient trading; for example, larger grants could be offered early in a 10-year program.

REFERENCES

Camacho, R. 1992. *Financial Cost Effectiveness of Point and Nonpoint Source Nutrient Reduction Technologies in the Chesapeake Bay Basin*. ICPRB Report 92-4. December.

Chesapeake Bay Program. 2000. *Summary of Public Comments to the Draft Nutrient Trading Guidelines and Fundamental Principles*. September.

Kerns, Waldon R., and K. Stephenson. 1996. *Market-based Approaches and Trading Conditions and Examples*. Watershed '96 Conference Proceedings.

McCatty, Thelma. 1999. "Discussion Paper #7–Trading Ratios and Exchange Rates." Prepared for the Chesapeake Bay Program's Nutrient Trading Negotiation Team.

Podar, Mahesh, Richard M. Kashmanian, Donald J. Brady, H. Dhol Herzi, and Theresa Tuano. 1996. *Market Incentives: Effluent Trading in Watersheds*. Watershed '96 Proceedings.

Preston, D.S., R. Smith, G. Schwartz, R. Alexander, and J. Brakebill. (No date). *Spatially Referenced Regression Modeling of Nutrient Loading in the Chesapeake Bay Watershed*.

Schary, Claire. Letter to Waldon Kearns, Professor of Resource Economics, Virginia Tech, October 17, 2000.

Stephenson, Kurt, W. Kerns, and L. Shabman. 1995. *Market Based Strategies and Nutrient Trading—What You Need to Know*. Prepared for the "Market-based Strategies and Nutrient Trading" workshop. November.

U.S. Environmental Protection Agency (U.S. EPA), Chesapeake Bay Program. 1999. *The State of the Chesapeake Bay: A Report to the Citizens of the Bay Region*. EPA 902-R99-013. October.

U.S. EPA, Office of Water. 1996a. *Effluent Trading in Watersheds Policy Statement*. February 9. *Federal Register* 61 (28): 4994–96.

U.S. EPA, Office of Water. 1996b. *Draft Framework for Watershed-Based Trading*. EPA 800-R-96-001. May.

U.S. EPA, Office of Water. 1999. *Final Report, Results of Water-Based Trading Simulations*. September.

U.S. EPA, Office of Wetlands, Oceans and Watersheds. 1998. *Effluent Trading in Watersheds Policy Statement*. http://www.epa.gov/owow/watershed/tradetbl.html.