An Examination of Key Elements and Conditions for Establishing a Water Quality Trading Bank

– White Paper –

Prepared for:
Office of Policy, Economics, and Innovation
and
Office of Water
U.S. Environmental Protection Agency
1200 Pennsylvania Ave. NW
Washington, DC 20460

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March 30, 2005

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Introduction

Water quality trading (WQT) is a market-based approach, which is considered a promising and cost-effective way of achieving water quality goals. One of the key objectives of many WQT initiatives is to encourage pollutant reductions from nonpoint sources, which can be used as offsets by regulated point sources.[1] Many offset programs are currently underway, but in a lot of cases, participation in them – especially by nonpoint sources – has been limited.

The February 28, 2005 White Paper *Applying Lessons Learned from Wetland Mitigation Banking to Water Quality Trading*, prepared by Abt Associates Inc. for EPA (Abt Associates Inc., 2005), identified two key impediments to successful WQT offset programs: legal/financial liability and thin markets. The White Paper also outlined a promising offset approach to overcoming these impediments, modeled after the North Carolina Ecosystem Enhancement Program (NCEEP). One of the major functions of the NCEEP is the purchase and resale of wetlands mitigation credits (see also Shabman and Scodari, 2004).

This paper further develops the idea of using a credit resale-type system to overcome some of the obstacles that have limited participation in many WQT offset programs. The credit resale approach described in this paper is that of a credit bank.[2] The principal element that distinguishes a credit bank from other types of trading programs is the fact that a third party takes ownership of any generated water quality credits, thus severing the connection between the credit seller and the credit buyer. In essence, a third party – either a government or a private entity, or a combination of both – buys credits (from various credit sellers and at variable prices and quality), normalizes these credits into a common unit, and sells them to one or more credit buyers, in the quantities they need.

While such an approach has the potential to remove some of the barriers to market entry currently observed in WQT, it should be noted that it is not a market-based approach where buyers and sellers interact directly and prices are set by demand and supply schedules. However, some of the market-based elements that would trigger competition and help reduce prices could be retained in a WQT credit bank, if it is designed carefully.

The remainder of this paper presents key elements and conditions that are important in setting up a WQT bank. The paper discusses potential variations of how each element might be designed and presents the pros and cons of each variation, including their potential implications on uncertainty, risk, and participation in the program. Wherever possible, "real life" examples, based on a series of case studies, are provided to better illustrate the concepts discussed in the paper. To preserve the continuity of the paper, the examples included in the various sections are generally given without the complete context of the particular system. Greater detail is provided in Section 4. It should be noted that few examples of

[1] The two main conceptual forms of WQT are cap and trade systems and offset programs. The discussion in this paper applies to offset programs only.

[2] It should be noted that the term "bank" as used in the context of a WQT program has a very different meaning from a bank in the wetland mitigation program. A wetland mitigation bank refers to the mitigation site itself – therefore, the "bank sponsor" is the entity responsible for credit production, which is often a private entity. In contrast, in WQT, the "bank" is the framework or institution that allows for the deposit and withdrawal of credits (just like a savings bank) – therefore, the "bank administrator" is the entity in charge of carrying out the day-to-day activities of the trading program, which is generally a government entity.

functioning WQT banks exist; where they do exist, banks are set up to meet the specific needs of the waterbody of concern. Banks can therefore vary significantly in their roles, responsibilities, and operational structure, and do not necessarily exhibit all characteristics of a comprehensive credit bank (i.e., a system that exhibits all characteristics of a credit bank).

The remaining sections are organized as follows:

- Section 1 provides a general description of a WQT bank system, including its main advantages compared to other types of trading systems.
- Section 2 presents the key elements and conditions that are necessary to set up a WQT credit bank. Highlighted elements include a *legal framework* that grants the bank the authority to engage in trading activities, including guidelines with respect to legal responsibility for pollutant reduction activities; a *bank administrator* who carries out many of the key functions of the program; a *capitalized fund* which enables the bank to secure initial credits; program conditions that provide the right *incentives for participation* among potentially reluctant credit buyers and offset providers; and *plans for bank and credit failure* that help prevent water quality degradation.
- Section 3 describes five core functions of a WQT bank, including forecasting credit needs, buying and normalizing credits, setting credit prices, and selling credits.
- Section 4 presents six case studies of trading programs that incorporate bank-like features. These trading programs vary substantially in their structure and operation and provide useful illustrations of the different options of setting up a bank-like system, the impediments encountered, and lessons learned.

1 General Description of a WQT Credit Bank

A WQT credit bank is one of the principal types of market structure for a WQT system. Three other types of market structure are a bilateral negotiation system, a third-party broker system, and an exchange (see also sidebar). Credit banks can be set up in a variety of ways, with the bank taking on different roles and functions to support the objectives of the WQT program. As a result, the term "bank" might be used to describe a number of different program structures, with correspondingly different roles and responsibilities for the entity in charge of operating the bank.

This paper uses two key elements to define a WQT credit bank. The first element is the involvement of a third party in the trade. This third party is neither the credit seller or buyer nor the regulatory authority. Presence of a third party differentiates a bank from a bilateral negotiation system and an exchange, both of which rely on direct transactions between the credit seller and the credit buyer. The second element is third-party assumption of ownership of the generated credits, including any risk that might be associated with not being able to sell the credits. This element differentiates a bank from a third-party broker system in which a third party facilitates the trades but does not take ownership of the credits.

In a general sense, a bank system can be described as follows: The bank purchases water quality credits from a credit seller, often a nonpoint source. Credit generation can be initiated through a variety of mechanisms, including a system of solicited or unsolicited applications submitted by the credit provider or through a competitive bidding system based on requests for proposal by the bank (see also discussion in Section 3.2 below). The bank then normalizes any purchased credits – which may have come from various credit sellers and at variable prices and quality – into a common unit and sells them to the credit buyers, generally point sources that need additional offsets to meet their waste load allocation (WLA). The regulatory authority, which is distinct and separate from the bank, oversees the trading program and is

Principal Types of WQT Market Structures

Bilateral Negotiation. In a bilateral negotiation system, credit buyers and sellers directly negotiate the terms of each trade. This system has relatively high transaction costs associated with information, contracting, and enforcement, but it has the advantage of accommodating trading of nonuniform goods. Bilateral negotiations are the most common structure of WQT markets.

Third-Party Broker. This system is similar to bilateral negotiation except that a third-party broker facilitates the trades. A broker can reduce transaction costs for buyers and sellers who are unfamiliar with the trading program and who might otherwise have difficulty finding trading partners.

Bank.[3] In this system, the link between credit buyers and sellers is severed. The bank converts water quality projects with variable price and quality into uniform credits, reducing search and information costs. Credits are sold for a price set by the bank. In its most comprehensive form, a bank eliminates all contractual and regulatory links between sellers and buyers and would require the transfer of legal liability for pollution reductions from the credit buyer to the credit seller or the bank.

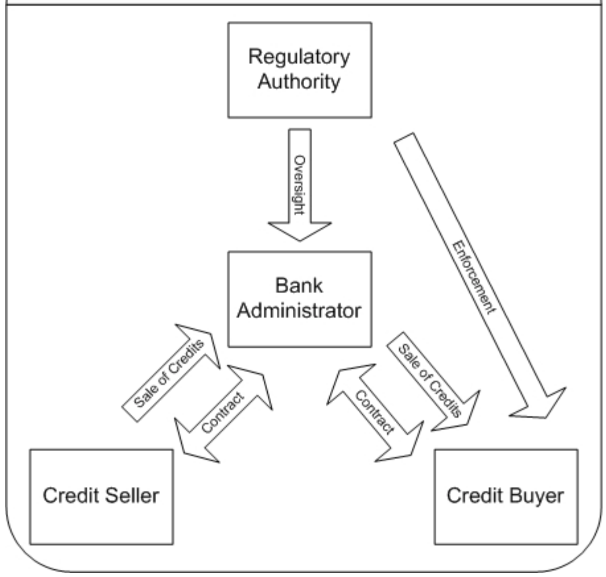
Exchange. An exchange is the complete form of a WQT market, characterized by its open information structure, fluid transactions between buyers and sellers, and a market-clearing price. A critical requirement for an exchange is uniformity of the products created by each seller. Currently, there are no water quality exchanges.

Adapted from Woodward et al, 2002

[3] Woodward et al. refer to this structure as a "clearinghouse".

responsible for enforcing water quality standards and permit requirements. The relationships and interactions between the four main players of a bank system – the bank, the credit buyer, the credit seller, and the regulatory authority – are depicted in Figure 1.

Figure 1: Water Quality Trading Bank System



A well-designed bank can have a number of advantages over other types of WQT systems. Most importantly, a bank system can help encourage participation in the program by reducing transaction costs and uncertainty, both on the supply side (credit sellers) and the demand side (credit buyers).

Reduce transaction costs: In a bilateral negotiation system, both credit buyers and credit sellers can incur substantial transaction costs. These transaction costs result from finding a suitable trading partner, negotiating the trade, and securing approval from the regulatory authority. In a bank system, program rules specify the procedures for both buying and selling credits. Credit sellers would still incur costs associated with project approval, but they would not incur the potentially substantial search and information cost of locating and negotiating with a point source (PS) credit buyer who might be unfamiliar with the proposed pollution control measures but remains liable for their success. On the side of the credit buyer, the potential for transaction cost savings would be even greater with a bank system since the buyer would simply purchase the credits in the quantity needed.

While a bank system has the potential to reduce the transaction costs of individual trades for both the credit buyer and the credit seller, it does require an upfront investment to develop the infrastructure and rules of the system. If these start-up costs have to be recovered from the program participants, some of the transaction cost advantages might be diminished. In general, a bank system is more efficient compared to a bilateral or broker system, if the operating costs (including start-up costs) are less than the transaction cost savings. Therefore, sufficiently large numbers of traders and trades are generally needed to justify the higher set-up costs and to capitalize on the economies of scale offered by a bank system (Woodward et al, 2002).

Reduce demand uncertainty (credit sellers): One of the main impediments to nonpoint source (NPS) participation in trading programs is the uncertainty of finding a buyer for the generated credits and having the trade approved by the regulatory authority. In a bank system, the bank administrator initiates credit generation and takes ownership of the credits, often prior to having identified a final credit buyer. A bank thus assumes the credit seller's risk of not being able to sell the credits. In addition, the bank approves the offset projects before credit generation activities begin, thus eliminating the risk that a trade may not be approved because of locational, temporal, or other considerations.

Reduce liability uncertainty (credit buyers): A major obstacle that limits participation of point sources in bilateral trading programs is associated with legal and financial liability. In bilateral negotiation and third-party broker systems, a point source purchases credits from a nonpoint source but remains legally liable for the success of the offset program implemented by the nonpoint source. The trade and any associated verification and monitoring requirements are written into the point source's National Pollution Discharge Elimination System (NPDES) permit. In the case of credit failure, the point source is responsible for achieving the required pollution reductions, either at its own operation or by securing offsets from another source. Removing the uncertainty associated with legal liability would likely make trading more attractive to point sources and encourage their participation in WQT trading programs. In a comprehensive credit bank system, the legal and financial liability of credit success would be transferred from the credit buyer (the point source) to the bank or the credit seller: generated credits would become "anonymous" once they are purchased and normalized by the bank. This means that a credit purchased by a point source would not be traceable to the producer who generated it. In such a system, the credit buyer – generally a permitted point source with pollutant reduction requirements – would no longer have the legal or financial liability for assuring the success of the pollutant reduction project once he makes the payment to the bank. However, the transfer of pollutant reduction liability from the credit buyer to the bank or the credit seller is not possible under the legal framework governing EPA's WQT policy. Nevertheless, there are alternative approaches that might reduce liability uncertainty for the credit buyer through mechanisms such as reserve/insurance pools of credits or shared liability. Section 2.1 below discusses the issue of legal liability and potential alternative approaches in more detail.

2 Key Elements/Conditions for Establishing a WQT Credit Bank

Initiating a WQT credit bank requires certain legal, administrative, financial, participatory, and contingency elements and conditions. This section details these considerations and illustrates relevant experiences in dealing with each.

2.1 Legal Framework

In order to establish a WQT credit bank, laws must be in place that allow this type of system. These laws must provide authority to the state or another entity to carry out the functions of a bank – subject to rules approved by the regulatory agency – including paying for pollution reductions, quantifying and normalizing credits, and reselling credits to permittees seeking an alternative means of meeting their discharge allocation. Most importantly, in a comprehensive WQT bank, which is characterized by the disconnect between the credit buyer and the credit seller, these laws would have to allow the final buyer of the credits to transfer his liability for pollution reductions.

Under current practice, the legal liability for pollution reduction is written into each discharger's individual NPDES permit. In a bilateral negotiations system, a trade would be recorded in the credit buyer's permit, including conditions for verifying and monitoring the success of the offset, which remains the legal and financial responsibility of the permittee. In a comprehensive bank system, where the bank takes ownership of the generated credits and where credits lose their identity, it would not be possible for the point source to retain its legal liability for the pollutant reduction. Therefore, a comprehensive bank can only be established if a transfer of legal liability is allowed. However, such a transfer is not allowed under the legal framework governing EPA's WQT policy.

One alternative permitting approach that has allowed some flexibility in transferring legal liability is watershed-based (or other group-based) permitting. A group-based permit establishes a shared liability for meeting an overall discharge limit for the entire group (e.g., a cap and trade approach). Within the group, the participants are free to meet their individual allocations or purchase credits generated by other group members. However, such a system generally only includes PS dischargers and does not address the objective of including nonpoint sources into a trading program. Since nonpoint sources are not subject to regulatory requirements, they are not part of or subject to group-based permits. As such, while group members are free to meet their discharge requirements through credits generated by other group members without encountering problems of legal liability, this would not be the case if they sought reductions from a nonpoint source.

A solution to the problem of addressing both NPS pollution and limitations with respect to the legal transfer of liability could be a system that is a hybrid between bilateral negotiations and a credit bank. In such a system the bank would purchase credits just like in a regular bank system. However, when the buyer purchases the credits, he purchases specific credits that remain linked to the credit producer. The point source might be able to choose between one or more of the mitigation projects that have been undertaken – selecting one that meets his specific pollutant reduction requirements – and retain the liability for the proper functioning of the project, just as in a bilateral trade. Such a system would have some of the advantages of a comprehensive WQT credit bank, including reducing demand uncertainty for the seller and reducing transaction costs for both the buyer and the seller. The bank would still need funds to finance the initial production of credits and would have the financial liability for not being able to find a buyer for the credits. However, the bank would not assume the legal responsibility for the pollution reduction. Once the sale is made, the buyer would carry the legal and financial responsibility for the success of the mitigation project, just like under a bilateral or brokered trade.

Another potential solution to limitations with respect to the legal transfer of liability is currently being implemented in the Great Miami River Watershed Water Quality Credit Trading Program in Ohio. In this program, the Water Conservation Subdistrict (WCS) of the Miami Conservancy District will bank credits generated by various management practices. Since the identity of credits is not retained, credit buyers are not liable for the success of specific projects. Rather, buyers receive credits in proportion to their contribution into the program fund (taking into consideration trading ratios). As a result, the credit buyers are collectively liable for the success of the management practices. However, the trading program incorporates two strategies to assure on-going NPDES permit compliance in the event of project failure: (1) a Management Practice Contingency Plan and (2) an Insurance Pool of credits. The Management Practice Contingency Plan lays out procedures for the timely and coordinated response to the failure of a management practice. The Plan will be developed and maintained in collaboration with the Ohio Department of Natural Resources. In addition, the trading program will use the Insurance Pool to cover any credit shortfalls as a result of project failure. Insurance Pool credits originate from the application of trading ratios and from water quality improvement projects subsidized by other sources of funding, including the Section 319 Nonpoint Source grant program. If the Insurance Pool contains insufficient credits to cover the shortfall from project failure, buyers would have to contribute additional funds to implement additional projects. However, it is anticipated that the Insurance Pool could contain up to 100 percent of traded credits, making a shortfall very unlikely. For a more detailed discussion of the Great Miami River Watershed Water Quality Credit Trading Program, see Section 4.3 below. (Hall, 2005; WCS, 2005a.)

2.2 Bank Administrator

The bank administrator is one of the key elements of a WQT credit bank. The administrator fulfills several important functions associated with the execution of the trading process. These functions may differ depending on exactly how the bank is set up but generally include forecasting demand for credits; securing, managing, and selling credits; tracking trades; managing the program budget; ensuring adherence to program rules; and communicating with the public and other stakeholders.

A bank administrator might be a private or a government entity. In addition, the administrator can be a single entity or a collaboration of groups and/or individuals – either private or public or a combination of both. What type(s) of entity is involved in the bank's administration could affect important programmatic aspects such as administrative costs, speed of decision making, participants' confidence in the program, and ultimately program success.

2.2.1 Government or Private Entity

To date, there are no known WQT programs with a single-entity, private bank administrator. This is not surprising. While there are no legal restrictions to setting up a private WQT bank, there are economic barriers. In most cases, the ultimate goal of a private entity is to maximize profits. To do so, it needs to have a reasonable expectation of receiving a timely and adequate return on its investment. The limited experience and the considerable uncertainties associated with WQT to date make the establishment of a private WQT bank a risky business.[4] The premise of a WQT bank, and one of its attractive features in stimulating participation, is that credits are generated, and paid for, before they are sold to a third party. This shifts the risk of credit demand uncertainty from the credit seller to the bank. A private bank would therefore assume the financial risk of not being able to sell all of the credits it purchased. In addition, a private bank, even if certified by a government agency, would still be subject to oversight and certain approval conditions from the regulatory agency. This would increase both the risk for the private entity bank and the transaction costs associated with the trading program.

In contrast to a private entity, the primary goal of a government-run WQT bank would not be to maximize profits. Clearly, the efficient use of scarce public resources is a concern, and a government-run WQT bank would not be sustainable in the long run if it incurred losses on a continuous basis. However, the ultimate goal of a public WQT bank would be to improve water quality. This difference in objectives allows public entities to enter a market – that of running a WQT credit bank – when private entities might not. Consider the case where a bank purchases water quality credits but is unable to resell them. For a private entity with a primary goal of making a profit, this scenario would be interpreted as a business failure and would discourage other private entities from entering this market in the future. For a government entity with a primary goal of improving water quality, on the other hand, the inability to sell credits does not necessarily mean that the WQT program is unsuccessful. Any credits that are generated but not sold constitute a net gain in water quality. In this case, the failure to sell credits simply means that the public, rather than a permitted point source, funded the water quality improvements.[5] While this outcome is clearly not the goal of establishing a WQT bank and would likely compromise the bank's ability to finance additional credits – possibly resulting in the abandonment of the program – the potential consequences of this scenario should not be sufficient to discourage the establishment of a government-run WQT bank, especially in light of the environmental benefits that would still be achieved.

One of the main advantages of having a private WQT bank would be potential cost-efficiencies in administering the bank. The assumption is that private entities might be able to provide some or all of the functions of a bank administrator at a lower cost than the government. In addition, private entities might have better access to sources of funding, which are needed to initiate banking activity (see also Section 2.3 below), than government entities. Neither one of these presumed advantages is necessarily the case. While it is reasonable to assume that a private entity might be able to avoid certain bureaucratic requirements of a public agency and therefore face lower administrative costs, a government agency might be in a better position to capitalize on pre-existing programs and infrastructure. For example, in a watershed with a TMDL, a government entity acting as the bank administrator might already be familiar with key issues – including point and nonpoint sources, pollutants of concern, hotspots, potential pollution control approaches, etc. – and therefore save considerable time and effort in carrying out functions associated with the establishment and execution of the trading process. Similarly, while a private entity might have greater flexibility in securing funding, a government entity might be in a better

[4] Even the most mature banking markets – e.g., those established under the wetlands mitigation banking program – have not generated enough data to indicate what qualifies as a reasonable rate of return and capital recovery that sufficiently addresses some perceived level of acceptable financial risk.

[5] It should be noted that water quality improvements would actually be *higher* if credits are not sold. Where a trade occurs, the net gain in water quality would be equivalent to the amount of pollutant reduction achieved by the credit seller minus the incremental discharge by the credit buyer over what he would have discharged in the absence of the trade. If no trade occurs, the net gain in water quality would be the full amount of the credit seller's pollutant reduction measure.

position to tie the WQT program into existing sources of funding, such as Section 319 grants or money from the Clean Water State Revolving Fund (CWSRF). For a more detailed discussion of funding considerations, see Section 2.2.3 below.

One way to capitalize on both the potential administrative efficiencies of a private entity and the access to funding of a government entity might be to have the private entity run the bank without being legally and financially responsible for failed credits or the inability to sell credits. In such a system, the funding for credit purchases could be provided by a government agency for use by the privately-administered bank. This could be done through a contract, with provisions for government oversight/approval and performance-based incentives or disincentives. For example, payment of full contract fees might be contingent on certain program milestones being met. Such private entity involvement might be particularly useful in states without prior WQT experience or where knowledgeable government personnel are unavailable to carry out these tasks themselves.

2.2.2 Single Entity or Collaboration

A second variation on the possible identity of a bank administrator is that of a single entity versus a collaboration of groups and/or individuals. Both potential forms have advantages and disadvantages.

Having a single entity act as the bank administrator consolidates power and decision making authority. This may have benefits, including a more streamlined, less bureaucratic system for decision-making since the administrator would not have to confer with multiple parties. Decisions would therefore be made more quickly and administrative costs would be lower. Some disadvantages of having only one entity act as the administrator include a lack of varying perspectives and insufficient checks-and-balances in the decision-making process. In addition, a single entity might have less credibility with the various stakeholders in the trading process, since it might appear to have biased objectives that are incompatible with the interests of some of the involved parties.

Having a collaboration of groups and/or individuals act as the bank administrator would provide numerous opinions and perspectives on the bank's operations. This type of bank administration would require explicit procedures for decision making and delegating authority and responsibility among the various members. One potential benefit of having multiple participants in the bank administration would be an increased likelihood that all the potential participants in the trading program have representation within the bank's administration, which could increase the participants' confidence in the bank's integrity. On the other hand, having divergent opinions may require a system of conflict resolution that does not unduly slow down decision making or create a prohibitively high administrative burden.

2.2.3 Funding Considerations

A final consideration for selecting a suitable bank administrator – be it private or public, a single entity, or a collaboration – is the need to finance the administration of the program. A private entity would seek to recover all its costs through profits from credit sales; this would raise credit prices and could potentially lead to a reduction in credit demand. A government entity would have to make available the personnel required to establish and run the bank, which would likely require additional resources. These could also be recovered through trading fees or higher credit prices, with the inherent risk that not all of the costs might be recovered if the program is not as successful as anticipated.[6] In the case of a private entity under contract to establish and run a WQT credit bank, the state or other government agency would also need to make additional funding available. The additional burden on any one entity would likely be the smallest in a collaboration of entities where responsibilities could be shared among several participants. However, likely inefficiencies from having multiple players and the need to come to an agreement on potentially controversial issues might negate some of this advantage.

2.2.4 Experience to Date

Most of the bank administrations observed to date are collaborations of different private and public interests, including government agencies, industry representatives, environmental groups, and nonprofit organizations.

The Kalamazoo River Water Quality Demonstration Project in Michigan was directed by a Steering Committee comprised of a collaboration of interests including local and state agencies, municipal and industrial dischargers, environmental consultants, nonprofits, and agricultural interests. This project demonstrated both the disadvantages and advantages of having multiple parties involved in the operation of a credit bank: on the one hand, conflicting interests and perceptions of the various stakeholders contributed to a drawn-out process of establishing trading rules; on the other hand, agricultural representatives on the Steering Committee were instrumental in eliciting the participation of farmers who did not trust regulators and were reluctant to join the program (Breetz et al., 2004). For more information on the Kalamazoo River Water Quality Demonstration Project, see Section 4.4.

2.3 Capitalized Fund

The second major component of a WQT credit bank is the availability of a capitalized fund. Such a fund is necessary because of the two-step process associated with the purchase and resale of credits: the bank purchases credits from the seller in advance of re-selling them to the credit buyer. While this system reduces the uncertainty for the credit seller and should help stimulate participation in the trading program, it also creates the need for the bank to secure funding to make the initial credit purchases.

The bank would initiate trading activity by using money from the fund to finance credit production. To encourage participation in the program, the bank might pay part of the credit price before the mitigation project has been completed. For example, service agreements with nonpoint sources in the Kalamazoo River Water Quality Demonstration Project, established payment schedules where 25 percent would be paid after agreeing on a conservation plan, 50 percent would be paid after implementation and completion of controls, and the final 25 percent would be paid after verification that the project operates as proposed (Breetz et al., 2004). When the credits are sold, the collected money would be used to repay the fund, and the bank can then draw from the fund again to finance the next round of credit generating projects. Ideally, once a fund has been capitalized, this flow of capital from the fund to the credit seller and from the credit buyer back into the fund can continue in perpetuity.

[6] In the Great Miami River trading program, administrative costs incurred by the bank administrator will be addressed through separate agreements with the credit buyers. This will allow the credit market to operate without administrative costs, which has the advantage of avoiding the perception by agricultural credit producers that additional expenses might diminish their opportunities to receive project funding (Hall, 2005).

2.3.1 Sources of Funding

The source of funding to initiate credit generation would depend on how the bank is set up (see discussion in Section 2.1 above). Private investors would secure the required capital from the private capital market. This may be difficult for an investor without pre-existing networks of trust within the financial industry since financial institutions could be very cautious about lending money for what might seem like an uncertain and risky business venture (see also discussion in the February 28, 2005 White Paper prepared for EPA; Abt Associates Inc., 2005). It is also possible that a privately-sponsored credit bank could obtain public funding towards for their WQT bank, perhaps through programs that supply grants or loans for water quality improvement projects.

Public sector involvement could come from some new source of state and/or federal funding or could be tied to programs and funds for water quality improvement projects that are already in place. Some potential sources of funding to capitalize the WQT bank include existing public funding for water quality improvement projects and contributions from potential credit buyers participating in the trading program:

- **Section 319 Grant Funds.** Section 319 of the Clean Water Act (CWA) declares that states, territories, and tribes can receive federal grant funds to help improve water quality by implementing best management practices (BMP), controlling nonpoint sources with a statewide program, implementing total maximum daily loads (TMDL), or developing other state regulatory programs. EPA distributes these funds to the state or territory after their water quality plan has been approved. The receiving entity must provide a 40 percent match (either in money or services) to these Section 319 funds. In fiscal year 2002, the Section 319 grant fund program distributed $237 million.

- **Clean Water State Revolving Fund.** The 1987 CWA amendments established the Clean Water State Revolving Fund (CWSRF), which provides annual capitalization grants to states, territories, and tribes. States and territories must match these federal funds with a 20 percent contribution (tribes are not required to provide a match). These entities can use this fund money to provide very low interest loans to complete projects that improve water quality. Loans can be given to local governments, private companies, organizations, and individuals. As loans are paid off, the money reenters the CWSRF and is loaned to another project. Approximately $3 to $4 billion is loaned out every year by the CWSRF, and the program has total assets of approximately $40 billion. By the end of 2001, 30 state funds had loaned out over $1.4 billion to fund NPS control projects. (U.S. EPA, 2003)

- **Agricultural Cost Share Program.** Agricultural cost share programs, often sponsored by the U.S. Department of Agriculture (USDA) or other state and federal agencies, provide grant money to help farmers install BMPs on their property. For example, North Carolina's Agricultural Cost Share Program began as a pilot program in 1983 to help address problems with NPS runoff into nutrient sensitive waters. Farms that participate in the program are given 75 percent of the costs for a BMP and must pay for the remaining 25 percent themselves. From 1984 to 1997, over 24,000 projects had been funded by the North Carolina cost share program, which was backed by approximately $75.5 million from state taxpayers (Williams 1997). The Great Miami River

Watershed Trading Program in Ohio is currently applying for USDA cost share grant money to supplement its funds for credit-generating BMPs (Hall, 2005).[7]

- **Credit Buyers.** Funding to initiate credit generation might also come directly from the point sources that are expected to buy the generated credits. This was done in the Tar-Pamlico Nutrient Reduction Trading Program, where the members of the Association provided $850,000 for demonstration projects to bank credits and additional funding for nutrient modeling and administrative activities (Breetz et al., 2004). The Great Miami River Watershed Trading Program also anticipates creating a project fund through direct contributions from participating point sources as well as other sources including the State Revolving Fund and bond proceeds (WCS, 2005a).

2.4 Incentives for Participation

In any type of WQT system, there are two necessary conditions for program participation: (1) the presence of a regulatory driver (often a TMDL) and (2) a sufficient price differential in pollutant reduction costs between the regulated entities (credit buyers) and potential offset providers (credit sellers). Section 1 discussed how a bank system might result in lower transaction costs compared to a bilateral negotiation system. Low transaction costs are vital in preserving a price differential that will encourage participation in the trading program.

This section focuses on the role of trust in the program and program acceptance, which is critical when establishing a new and unfamiliar system. The section discusses the importance of program rules, availability of information, and certainty about the program's future.

2.4.1 Program Rules

A key element of encouraging participation in a newly established WQT bank is the development of clear, transparent, fair, and enforceable program rules that not only ensure that water quality goals are met but also instill a measure of trust and certainty among potential program participants. Program rules should define how the core functions of the bank will be carried out – including all activities associated with the purchase, normalization, and sale of credits (see also Section 3 below). Program rules should also include guidelines for the estimation of NPS load reductions, BMP monitoring and maintenance requirements, and remedial procedures in the case of credit or bank failure.

The responsibility of establishing WQT program rules can fall either to the regulatory authority, the WQT bank, or a combination of both. Many states, such as Maryland, Pennsylvania, Virginia, West Virginia, and Wisconsin, have begun exploring statewide WQT program rules, but have not yet finalized these rules. Michigan, on the other hand has established statewide WQT regulations that include rules for "eligibility requirements, baselines, water quality contributions, credit banking, notification and registration requirements for credit generation and use, the water quality trading registry, delineation of watersheds, program evaluation, and compliance and enforcement." Michigan conducted a pilot program,

[7] It should be noted that the use of funds from programs such as USDA's cost share program might impose limits on the right to these credits. USDA has generally considered credits generated through its program the property of credit producers, with the right to resell these credits. To avoid paying for the same pollution reduction twice, trading rules should specify which credits are eligible for program participation. (Hall, 2005)

the Kalamazoo River Water Quality Demonstration Project, which helped inform their development of these statewide WQT program rules (Breetz et al., 2004). For more information on the Kalamazoo River Water Quality Demonstration Project, see Section 4.4.

In circumstances where no statewide WQT rules have been established, trading programs have to establish their own rules. This should be done in close coordination with the regulatory authority to avoid disagreements and potential enforcement issues later on. In the example of the Great Miami River Watershed Water Quality Credit Trading Program, EPA concerns about the initial design of the program, including key trading rules, required the modification of some components of the program. These changes were made before the program began, thus avoiding legal problems for the program participants. The Great Miami program rules were developed by the bank administrator with broad input received in over 30 meetings with various stakeholders, including county soil and water conservation district boards, joint boards, wastewater treatment plant operators, and community-based watershed organizations. Additionally, representatives from these stakeholder groups also serve on the Project Advisory Group and will participate in developing project criteria for the selection of projects for funding (WCS, 2005a). For more information on the Great Miami River Watershed Water Quality Credit Trading Program, see Section 4.3.

2.4.2 Availability of Information

A change to a new system or method of operation always entails uncertainty. In the case of WQT credit banks, few, if any, successful examples exist. As a result, both potential credit sellers and buyers might be reluctant to participate in a system that is unfamiliar, and has unproven benefits and potential risks. In addition, other stakeholders – including environmental groups and community representatives – might be skeptical of trading programs in general and banking programs in particular, if no direct link between credit buyers and credit sellers can be established.

Availability of information plays a crucial role in overcoming reluctance in participation on the part of the credit buyers and sellers, and resistance towards program establishment on the part of other stakeholders. From the early planning stages, broad stakeholder involvement and dissemination of information is important. The better the different parties understand the program, the more likely the program is to succeed. Initial information should include details about the objectives of the program, how it functions, the different players and their roles, program rules, and guidance to assist potential participants. Once the program gets underway, access to information on the supply and demand of credits, what trades have occurred, and at what prices would allow participants to make informed decisions about the feasibility of their own participation and keep the regulatory agency and the general public informed about program activity. A good information system should also help to keep transaction costs low because credit sellers and buyers can more easily interact with the bank and identify how many credits they have to sell or need to buy.

Providing information on the banking program is the responsibility of the bank administrator. In the early phases, public meetings are a useful venue to provide the opportunity for input, questions, and concerns to the broadest possible audience. In addition, a project advisory group or other type of committee could be created to provide a more formal channel for stakeholder involvement in the design and implementation of the program. Information on the program, including rules, responsibilities, and current and past offset projects and trades should be readily available through a website, newsletter, or other easily accessible media.

In the Kalamazoo River Project in Michigan, one of the main obstacles in setting up the program was getting nonpoint sources, particularly farmers, involved in generating credits. One of the main barriers to farmers' participation was their distrust of the regulators involved in the trading system. The Steering Committee, which acts as the clearinghouse, was eventually able to soothe some of the farmers' fears through face-to-face meetings and by allowing the farmers to work with agricultural contacts that they already knew and trusted (Breetz et al., 2004). For more information on the Kalamazoo River Project, see Section 4.4.

2.4.3 Certainty about Future of System and Regulatory Status

With few examples of real-life, successful credit banks, there is no proven track record to allay fears that the system will not fail. Participants want to know that the system will be in place in the long-run with a sufficient supply and demand for credits. For offset providers, the bank system in itself provides added certainty of credit demand compared to a bilateral negotiation system. Credit purchasers, on the other hand, require certainty that there will be a stable supply of credits in the future, that they will be allowed to purchase these credits, and that the credits will allow them to meet their permit requirements. The risk of program failure might make it more attractive for them to mitigate their own discharges, thus reducing the potential credit demand.

One way of reducing concerns about the future of the program is to incorporate the system into other pre-existing water quality programs, e.g., agricultural cost share programs. This can offer a number of potential benefits, such as lower administrative and transaction costs through shared program infrastructure and increased credibility because participants are already familiar with certain components of the system. For example, in the Tar-Pamlico Nutrient Reduction Trading Program, the North Carolina Agriculture Cost Share Program is used to initiate and monitor the successful implementation of BMPs at nonpoint sources. This pre-existing infrastructure helps keep the transaction costs of the program lower than they would be otherwise (NCDWQ, 2002). For more information on the Tar-Pamlico Basin program, see Section 4.6.

2.5 Plans for Project/Credit or Bank Failure

A final important element when setting up a WQT credit bank is a contingency plan in the event of failure. Two main areas where failure might occur are project/credit failure and bank failure. Both types of failure are discussed in this section.

2.5.1 Project/Credit Failure

Project/credit failure occurs when the project implemented by the credit seller does not deliver the number or quality of credits required by the contractual agreement between the credit seller and the bank. Project/credit failure might be the result of adverse meteorological circumstances (e.g., a storm destroying a BMP), implementation difficulty (e.g., the proposed project is not working as planned or modeled discharge reductions are not achieved), or through negligence of the credit provider.

Potential consequences of project/credit failure are degradation of water quality, financial losses for the bank or the credit buyer, and enforcement actions against the credit buyer who is in danger of defaulting on his legal pollutant reduction responsibilities. A number of mechanisms can be used to safeguard against or reduce the adverse effects of project failure. Which mechanisms should be employed will likely depend on the circumstance of the problem, including the magnitude of failure and its cause:

- Including information in the trading program rules on procedures for project/bank failure so that bank personnel and credit buyers and sellers are aware of the potential for project/credit failure and the resulting steps that will be taken.
- Providing bank personnel with training to enable them to identify credit sellers or projects with potential for problems.
- Establishing project selection criteria that encourage projects with a greater likelihood of success through the use of more favorable trading ratios. In addition, project selection might include inspection of the site, and in some cases, performing limited tests.
- Tieing credit payments to the achievement of project implementation milestones.
- Developing procedures to document due diligence efforts taken by the credit provider.
- Establishing a reserve pool of credits that can be used to protect credit buyers against enforcement in the case of project/credit failure.
- Including warranties or assurances in the contractual agreement that are designed to protect the bank from losses stemming from under-performing or default credits. The contracts should specify the BMPs and controls implemented to generate credits and criteria used to determine when credits are in default, and outline remedial actions the credit seller is obligated to make to bring the credits back into qualified status if necessary.

In general, it is in the best interest of all involved parties if project/credit failure is not resolved through legal channels but through remediation of the problem. Unless failure is caused by negligence on the part of the credit provider, the first course of action should be to provide assistance to the credit provider to solve the problem. The prospect of legal action or financial liability against credit providers is likely to cause distrust among potential participants and discourage participation in the program.

For example, the Great Miami River trading program uses an Insurance Pool to address the problem of project failure. To protect credit buyers from enforcement actions, insurance credits would be used to cover credit shortfalls. As a result, "[a]gricultural producers do not have to worry about facing legal battles with credit buyers if final credits are less than predicted or projects fail entirely…" (Breetz et al., 2004). In this program, contractual agreements between the bank and the credit provider are similar to those used in standard cost share programs. As a result, participation in the trading program is no different to the credit provider than participation in the cost share program.

Another relevant example of dealing with the uncertainty of the project success is the Kalamazoo River demonstration project. In this program, the Steering Committee acted as a clearinghouse and facilitated trades of phosphorus credits from nonpoint sources to point sources. In addition to using trading ratios to account for uncertainty, nonpoint sources were also paid for their phosphorus controls in three separate installments based on the progress of their project implementation: 25 percent after agreeing on an implementation plan, 50 percent after the controls were completed, and 25 percent after the controls proved to operate as originally intended (Breetz et al., 2004).

2.5.2 Bank Failure

Bank failure refers to the scenario where the entire trading program is deemed unsuccessful. This could be the result of failure to achieve water quality standards, lack of participation in the program, or lack of funding. Since the prospect of bank failure is likely to discourage participation in the program, appropriate safeguards and controls should be in place to minimize the risk of bank failure. In addition, contingency plans need to be articulated to provide certainty to participants that they will not be negatively affected by the abandonment of the program. For credit providers, this includes assurances that they will be paid for their projects; for credit buyers, this includes the certainty that they will not be subject to enforcement actions if the entire program fails.

3 Key Functions of a WQT Credit Bank

A bank can fulfill a number of functions in a WQT program. These functions may include forecasting demand for credits; buying, managing, and selling credits; setting prices; tracking trades; managing the program budget; ensuring adherence to program rules; and communicating with the public and other stakeholders. This section describes five of the core functions of a WQT bank: (1) forecasting credit needs; (2) buying credits; (3) normalizing credits; (4) setting credit prices; and (5) selling credits. Some aspects of these functions are important in any type of WQT system and are not unique to a bank-based system. The following discussion focuses on those aspects that present unique challenges or opportunities in a bank system.

3.1 Forecasting Credit Needs

A WQT credit bank often initiates the generation of credits before knowing exactly who the final buyers of the credits will be and how many credits they will need. If the bank purchases too many credits, it has financed water quality improvements out of its own funds, potentially jeopardizing its ability to initiate further credit generation and – ultimately – its own financial stability. If it purchases too few credits, PS dischargers in need of offsets will not be able to acquire the required credits, potentially leading to doubts about the reliability of the program. Developing good estimates of credit needs is therefore one of the key functions of a successful WQT bank.

There are several ways a WQT bank might forecast credit needs. Information on current PS discharges, regulatory requirements driving the need for offsets, and price differentials should provide a good basis for estimating likely PS interest in credits. The more stringent new or anticipated regulatory requirements are compared to current discharge levels, and the greater the price differentials between PS and NPS controls, the greater the likelihood that point sources will seek offsets to meet their discharge limits. For example, an economic analysis of water quality trading opportunities in the Great Miami River Watershed in Ohio analyzed effluent reduction needs based on pending statewide nutrient standards and current effluent discharges of point sources in the watershed. Estimated reduction needs were then translated into potential credit demand, taking into account trading ratios (Kieser & Associates, 2004).[8]

Another good source of information about likely credit needs might be participants in the bank administration, if it consists of a broad collaboration of interests. Industry representatives are likely to be in tune with the concerns of the regulated dischargers in the trading area and might provide insight into potential participation, or solicit information from their constituents.

One promising approach to avoiding credit surpluses or shortfalls might be to require advance commitments of participation as well as advance funding. For example, the Great Miami River Watershed Trading Program encourages potential buyers of credits to sign up for the program in advance of their NPDES permit requirements and offers more favorable trading ratios as an incentive. In addition, credit buyers capitalize the project fund before management practices are implemented. As a result, the bank administrators know the quantity of credits needed and do not have to rely on more uncertain forecasts. For such an approach to work, however, sufficient incentives for participation (e.g., cost

[8] Note that the forecast of potential credit demand was used to evaluate the feasibility of establishing a trading program rather than to estimate the number of credits to be generated.

differentials) and a relative high degree of confidence in the trading program are necessary. Otherwise, potential participants may be reluctant to commit to participation.

3.2 Buying Credits

Once a credit bank has determined the number of credits needed, either by estimation or expressed demand, it has to initiate credit generation. The bank has to identify eligible offset providers, negotiate contracts for credit generation, and pay the providers for their activities. There are several ways a bank might select offset providers. One option is through direct solicitation of potential eligible nonpoint sources. For example, the Steering Committee in the Kalamazoo River Water Quality Project identified potential NPS sites through aerial photographs, topographic maps, and county ownership maps (Breetz et al., 2004). A second option is an unstructured application system, where interested offset providers submit applications to the bank administrator, who would then evaluate the applications against the projected credit needs. A third option is a more formal request for proposals (RFP) process. The RFP would specify the number and type of credits needed and would ask potential credit producers to submit bids regarding pollution control projects, the projected number of credits, and the cost. The bank would then evaluate each proposal and select one or more offset providers, based on cost, likely performance of the project, and other selection criteria. Built into this system could be resources that help bidders calculate their potential to create credits, as well as information on the ratios and other incentives used to encourage the creation of reliable credits.

Once producers of credits have been selected, the bank administration enters into a contractual agreement with the credit providers. The contract should lay out the terms for important issues such as project specifications, the schedule, terms of payment, remedial actions in the case of project failure, etc. Payment for the generation of credits generally occurs before the bank can sell the credits, so the bank must have the funds to cover the production costs of the credits. The contract should also include a schedule for payments. One option is to pay the producer of credits on a defined schedule, based on the different milestones of the project's construction and completion. The credit producer might also have to provide financial assurances for the success of the project, which might include the reimbursement of received payments to the bank and potential penalties in the case of project failure (see Section 2.5.1 for more information). However, care should be taken that the terms of the contract do not discourage participation in the trading program.

3.3 Normalizing Credits

Offsets sold through a WQT bank must be converted into a standardized unit. Tradable offsets might be expressed in pounds or as credits. However, discharges of pollutants take different chemical forms and occur at different times, in different amounts, and in different parts of a waterbody. In addition, NPS offsets are inherently more uncertain than PS pollutant reductions. Credit normalization and trading ratios are used to account for the many variations in the character of offsets and their potential effect on water quality.

This section focuses on two aspects of credit normalization that pose unique challenges in a WQT bank system: temporal and spatial effects.

3.3.1 Temporal Effects

Temporal effects can be important when normalizing the credit units. Credits can be sold by the day, week, month, season, year, or other time period. Deciding on the duration of a credit's validity depends on the pollutant being traded, its biogeochemistry with the environment to which it is discharged, and the timing of its discharge. Seasonal discharges of nutrients from agricultural runoff, for example, primarily occur during the growing and rainy seasons.

For example, two different sources might discharge phosphorus into a river. One of the dischargers is a point source that discharges a small amount of phosphorus daily via its outfall pipe. The other discharger is a farmer who generates high concentrations of phosphorus runoff from fertilizers during the growing and rainy seasons. A reduction in the farmer's discharges – attained through a trade – could have very different effects on the river's water quality compared to an equivalent reduction by the point source. In the absence of a trade, the point source would reduce the amount of phosphorus discharges by an equal amount every day. In contrast, with a trade, the farmer might reduce phosphorus discharges by the same amount during that year, but the reduction would be concentrated during a few weeks or months. Depending on the pollutant and the water quality problems in the watershed, this difference in the timing of equivalent total amounts of pollutant discharges might need to be taken into account when normalizing credits. For example, a watershed might experience seasonal eutrophication during the growing season. This watershed would benefit from a trade that would lead to a greater reduction in phosphorus loadings during the growing season compared to reductions achieved by the point source. On the other hand, a watershed that has continuously high concentrations of phosphorus might require loading reductions throughout the year to meet water quality goals. This watershed would have to ensure that any trades do not concentrate loading reductions during the growing season at the expense of the rest of the year.

Other temporal factors that should be established in the credit bank's trading rules are credit expiration and credit retirement. Typically, credits are produced by either a change in process or production levels, by the installation of a new piece of technology, or by the adoption of a BMP. EPA policy does not permit the banking of credits for use in different time periods, e.g., the following year. Rather, credits have to be used concurrent with their production. As a result, credits will only last as long as the process or production levels are held constant or for as long as the technology or BMP continues to function efficiently. Additionally, the bank could consider the option of "retiring" credits from the trading system as a way to force greater improvements in environmental quality. For example, if a credit bank required that a discharger pay for credits in excess of the amount needed to ensure a margin of safety, the bank could then retire the extra credits.

3.3.2 Spatial Effects

The trading area of the credit bank should be defined through the program rules or other enabling legislation. If established in the context of a TMDL, the area of the program is likely defined by the coverage area of the TMDL. A TMDL may also include locational information of potential credit sellers and buyers, and provisions for WQT to include trading ratios or equivalencies used to determine the number of credits associated with the amount of pollution reduced from BMPs or controls. Information on potential credit sellers and buyers combined with credit ratio or equivalency specifications can be used to guide WQT credit bank criteria for addressing credit failure risk and to avoid hotspots.

In a bilateral system, the regulator can evaluate each trade for potential hotspots and control for this through equivalency ratios and other trading limitations. In a comprehensive bank system, such direct control over the locations of the offset and the increased discharge would not be possible. Instead, the potential for hotspots would be reduced through general equivalency ratios that provide incentives or disincentives for credit buyers and credits sellers in certain locations. For example, a credit seller located in an impaired area (or upstream from an impaired area) might need to produce only a one-pound reduction of a pollutant to get a single credit, whereas a credit seller located in a non-impaired area would need to produce a two-pound reduction of a pollutant to get a single credit. Similarly, a credit buyer located in an impaired area (or upstream from an impaired area) may need to purchase two credits for each additional pound of pollutant discharged, while a credit buyer located in a non-impaired area would only need to purchase a single credit. Such a system would reflect the greater benefit of nonpoint sources reducing discharges and the greater harm of a point source increasing discharges in an impaired area (or upstream from an impaired area) and would result in the following equivalency ratios:

Potential Equivalency Ratios		
	Location of Credit Seller	
Location of Credit Buyer	***Impaired Area*** *(needs to achieve 1 pound reduction per credit)*	***Non-Impaired Area*** *(needs to achieve 2 pounds reduction per credit)*
Impaired Area *(needs to buy 2 credits per pound discharged)*	2 credits/lb discharged * 1 lb reduction/credit = 2 lbs reduction/lb discharged **→ 2:1 equivalency ratio**	2 credits/lb discharged * 2 lbs reduction/credit = 4 lbs reduction/lb discharge **→ 4:1 equivalency ratio**
Non-Impaired Area *(needs to buy 1 credit per pound discharged)*	1 credit/lb discharged * 1 lb reduction/credit = 1 lb reduction/lb discharged **→ 1:1 equivalency ratio**	1 credit/lb discharge * 2 lbs reduction/credit = 2 lbs reduction/lb discharge **→ 2:1 equivalency ratio**

While such a system cannot guarantee that hotspots will be avoided, it provides disincentives for trades with hotspot potential in two ways: (1) a nonpoint source is rewarded for reducing pollution in impaired areas and (2) a point source is discouraged from increasing pollution in impaired areas. This results in a relatively high equivalency ratio of 4:1 when a point source in an impaired area buys a credit generated by a nonpoint source in a non-impaired area. Such ratios would raise the cost to the point source and would discourage trading. The designation of impaired and non-impaired areas would require occasionally monitoring and potential reclassification, but should be done in a manner that would not cause increased uncertainty among the participants.

In the Cherry Creek Trading Program, ratios are used as a way to compensate for different effects of discharges in different locations within the watershed. The minimum ratio used in the program is 2:1 and can be adjusted up to 3:1. These adjustments are based on the locations of the credit producers and credit purchasers and their relation to the reservoir: when the credit buyer is closer to the Cherry Creek Reservoir than the phosphorus removal project, the ratio applied to the trade will be closer to 3:1 (Breetz et al., 2004). Similarly, the Great Miami River Watershed trading program anticipates using trading ratios that depend on the water attainment status at the buyer's discharge point: facilities located in impaired waters face higher trading ratios than facilities located in fully attaining waters (WCS, 2005a).

The credit bank could also consider using other trading limitations to prevent hotspots. For example, program rules may prohibit PS dischargers in certain high-pollution locations from participating in the program. Alternatively, the rules may specify that offset providers must be located in certain areas, e.g., upstream from problem areas in the watershed. A third alternative would be to subdivide the trading area into regions and only allow point sources to purchase credits generated in the same region. Each of these measures would reduce either the supply of credits or the demand for credits, or both, and may lead to program failure as a result of limited participation.

A final approach to preventing hotspots would combine the elements of a credit bank with elements of a brokerage or bilateral negotiation system. In such a system, credits could be banked and sold but would not lose their identity. Banked credits would then be sold only if certain conditions are met, e.g., that the credit was generated upstream from the discharger. Such a rule is being implemented in the Great Miami River Watershed trading program, which specifies that any credits purchased to offset PS discharges must be generated upstream from the point of discharge (WCS, 2005b). Again, such a restriction might have the negative consequence of limiting the number of allowable trades, which might hurt the participation of both credit suppliers and purchasers.

3.4 Setting Credit Prices

Once the bank has purchased the credits, a uniform price needs to be set for the normalized credits. This price needs to take into account the varying prices paid by the bank to buy the credits; financial and legal assurances, if any, secured from the credit provider; bank startup and operational costs; and the need to maintain a sufficient price differential.[9] Credit prices are often set by dividing the total cost of credit generation by the number of credits.

Administrative costs – including all the costs associated with the startup and operation of a credit bank – generally have to be recovered from the program participants. This includes money needed for infrastructure development, employees, record keeping, information availability, and monitoring. Administrative costs can be substantial, although integrating a new trading program into a pre-existing program, such as a cost share program, might reduce costs. Administrative expenses can be recovered either through the price of the credit or through a separate fee that sellers and/or buyers of credits must pay for participating in the WQT program. For example, in the Cherry Creek Watershed Program, entities submitting project applications for credit generation must pay a $2,500 fee to cover the costs to review the proposal, and entities seeking credits must pay a $500 fee. Both fees are paid to the bank administrator (Breetz et al., 2004).

It is important that these administrative costs are considered when estimating the potential supply and demand of credits. The higher user fees to cover administrative costs are, the more likely they will act as a barrier to market entry, particularly for those who are already reluctant to participate. When the administrative costs are incorporated into total costs and passed along in the credit's price it is important that the total cost does not exceed the cost for dischargers to meet their water quality goals without trading.

[9] Section 2.2.1 discussed why private companies are currently unlikely to establish a WQT bank. However, if such a private bank were to be established, a sufficient profit margin would have to be incorporated in the price of credits.

3.5 Selling Credits

The last step in the credit resale cycle is selling the final normalized credits to the buyers. Similar to the contracts between the bank and the credit provider, the bank administration would enter into a contractual agreement with the credit buyers. Such contracts would specify the number of credits to be purchased, the period over which the credits are valid, the credit price, and provisions in case the bank fails to deliver the agreed upon number of credits.

Allowing credit purchasers to buy credits through a credit bank has the potential to reduce the transaction time and costs typically associated with trades made through a bilateral negotiation system. This streamlined process and ease of knowing whom to contact in order to purchase credits may increase the potential for participation of credit buyers. In addition, the bank might provide incentives for credit buyers who commit to purchasing credits over several years, which would reduce uncertainty for the credit providers, the bank, and the credit buyers.

Finally, depending on the accounting system used by the credit bank, the selling of credits through the bank system could add another layer of transparency to the WQT process. In theory, this increased availability of information should make this market-like system function more efficiently. For example, this transparency might allow others to view who has purchased credits and in what quantities. However, care has to be taken that information on credit buyers does not cause negative publicity that can sometimes be associated with pollutant trading programs and the perception of “buying the right to pollute.”

4 Selected Water Quality Trading (WQT) Case Studies

This section summarizes six case studies, which are examples of WQT programs that incorporate different characteristics and concepts of a WQT bank.[10] These trading programs vary substantially in their structure and operation and provide useful illustrations of the different options of setting up a credit bank, the impediments encountered, and lessons learned. Because few real-world examples exist, some case studies included here may not fit the narrow description of a WQT bank, but were included because they provide a useful example of a bank's structure or operation.

Many of these case studies have been referenced throughout the text of this White Paper to provide real-world examples of different bank components. This section provides the greater context of these examples and helps further develop the understanding of how a WQT credit bank may be structured and operated.

The research conducted for this paper identified the Great Miami River Watershed Water Quality Credit Trading Program as one of the most promising examples of establishing a bank system that has the potential to capitalize on the advantages of a trading bank while at the same time addressing the constraints with respect to the transfer of legal liability for pollution reductions. As a result, more information is provided on this program relative to the other case studies discussed in this section.

4.1 Chatfield Reservoir Trading Program

The Chatfield Reservoir is a state park and recreational area in Colorado that is part of a 3,000 square mile watershed. High levels of phosphorus discharged into the watershed by point sources and nonpoint sources began causing eutrophication. To deal with this problem, the Chatfield Reservoir Control Regulation (Regulation #73) established a total maximum annual load (TMAL) – which limits a point source to 1.0 mg/l total phosphorus as a 30-day average concentration – and guidelines that allow the trading of phosphorus.

The Chatfield Watershed Authority – comprising local towns, districts, counties, agencies, industries, and church camps – acts as a clearinghouse credit bank for the Chatfield Reservoir and is responsible for implementing Regulation #73 (Breetz et al., 2004). Regulation #73 addresses different mechanisms that a point source can use to obtain additional phosphorus wasteload allocations (WLA). These mechanisms include both the functions of a bank system (NPS-to-PS trades and a reserve/emergency pool of phosphorus credits) and a bilateral system (PS-to-PS trades) (Chatfield Watershed Authority, 2000).

The Authority develops strategies and programs as incentives to get nonpoint sources to reduce phosphorus discharges (Breetz et al., 2004). Nonpoint sources are allowed to deposit phosphorus credits into the "Authority Removal Credits" pool. The Chatfield Watershed Authority applies a 2:1 trading ratio[11] to the credits and then deposits them into the "Authority Discharge Credits" pool. When a point

[10] It should be noted that the resources available for this paper did not allow detailed research into each of these case studies. The presented information is based on the findings of a comprehensive survey, documented in *Water Quality Trading and Offset Initiatives in the U.S.: A Comprehensive Survey* (Breetz et al., 2004), and other publicly-available sources, as referenced.

[11] For every single-pound credit of phosphorus sold by the bank, two pounds of phosphorus discharge is reduced.

source exceeds the 1.0 mg/l limit, they must apply for the chance to increase their discharge through NPS trading and pay a $100 fee that covers administrative costs (Breetz et al., 2004).

Point sources can also adjust their wasteload allocations for phosphorus through a trade with another point source. In the trade of phosphorus allocations, both point sources involved must submit applications to the Chatfield Watershed Authority. The applications must also be accompanied by an agreement between the two owners of the point sources detailing the changes in wastewater flow and phosphorus treatment.

Another mechanism available to a point source to increase its allowable phosphorus wasteload allocations is the reserve/emergency pool of credits held by the Chatfield Watershed Authority. When a point source applies for credits from the reserve/emergency pool (i.e., bank), they must specify how many pounds of phosphorus are desired. Additionally, a point source can voluntarily donate credits to the reserve/emergency pool and in exchange they will be given the first opportunity to use these phosphorus credits if they need to meet their wasteload allocations (Chatfield Watershed Authority, 2000).

The Water Quality Control Commission must approve all of the Chatfield Watershed Authority phosphorus wasteload allocation transactions on a case-by-case basis no matter which mechanism is used. Once a point source successfully purchases phosphorus credits, the credits are incorporated into the point source's permit by the Water Quality Control Division. These changes can also be incorporated into the regulation as an amendment during its triennial review.

Thus far, only one trade has occurred in the Chatfield trading program. A wastewater treatment plant bought credits from the reserve/emergency pool to help cover the impacts of building a new facility. Otherwise, until regulations limiting PS discharges become more stringent, there is not enough demand for the phosphorus credits (Breetz et al., 2004).

4.2 Cherry Creek Basin

The Cherry Creek Watershed covers nearly 380 square miles and supports recreation, fisheries, and water supplies in the Denver, Colorado area. Phosphorus loadings in Cherry Creek – primarily from municipal wastewater treatment facilities, urban and agricultural stormwater runoff, gravel mining, and septic systems – were recognized as a problem in the mid-1980s. A total maximum daily load (TMDL) was put in place in 1989, and point sources were allowed to increase their WLA by reducing NPS phosphorus loadings. This informal trading system lasted until the Cherry Creek Basin Water Quality Authority ("Authority") developed a formal framework for phosphorus trading to help improve and protect Cherry Creek's water quality. In 2001, the TMDL was replaced with a TMAL that authorizes the trading of credits and gives the Authority the legal basis to manage the trades.

Under the TMAL, nonpoint sources are expected to meet a total load allocation, but no single nonpoint source is required by regulation to meet a specific amount. Additionally, the Cherry Creek Reservoir Control Regulation requires that new development must be accompanied by high level BMPs. In order for a nonpoint source to generate credits with this regulation in place, they must either implement BMP on developed land that has no BMPs, or install new BMPs or retrofit an existing BMP so that it exceeds current phosphorus removal requirements.

Credits produced by nonpoint sources are calculated based on either site-specific monitoring or, if that is not available, on experience from other similar existing projects. The minimum trade ratio used is 2:1, but can be adjusted up to 3:1 based on the locations of the point source and nonpoint source and their relation to the reservoir. Point sources are held fully accountable for meeting their permitted discharge levels, which means that the point source is liable if a nonpoint source falters on a project used to generate the credits. The Authority approves all credit trading and carries out a monitoring program. This monitoring helps the Authority estimate the effectiveness of BMP and pollution reduction facilities (PRF) and also requires that point sources submit monthly reports of their 7- and 30-day average discharges of phosphorus. Those submitting project applications for credit generation must pay a $2,500 fee to cover the costs to review the proposal, and those seeking credits must pay a $500 fee.

Thus far, only a handful of trades have occurred. It is expected that as the population in the area continues to grow and increases the pressure on municipal wastewater treatment facilities, the trading of phosphorus credits will increase. Despite the lack of trading activity, the trading program has been referred to as a current success that will continue to improve water quality in Cherry Creek in the coming years (Breetz et al., 2004).

4.3 Great Miami River Watershed Water Quality Credit Trading Program[12]

The Great Miami River watershed in Ohio consists of four sub-watersheds that cover 4,000 square miles. Approximately 40 percent of the rivers and streams in the Great Miami River watershed do not meet Ohio's water quality standards. The Great Miami River Watershed Water Quality Credit Trading Program ("trading program") is currently awaiting endorsement by the Ohio EPA and is due to begin in 2005 or 2006. The trading program is designed to reduce nutrient loadings through the implementation of BMPs on agricultural lands in the area.[13] The main regulatory drivers for the program are new statewide nitrogen and phosphorous criteria and discharge limits anticipated for the watershed in 2008. In addition, nearly all sub-watersheds are scheduled for TMDL development. The trading program will be managed by the Water Conservation Subdistrict (WCS) of the Miami Conservancy District (MCD) with participation from agricultural producers, wastewater treatment plants, the U.S. EPA, the Ohio EPA, county soil and water conservation districts (SWCD), the Ohio Department of Natural Resources, and the Ohio Farm Bureau Federation. County SWCDs will be the link between the agricultural producers and the trading program.

The trading program will allow public and private entities, primarily wastewater treatment plants, to purchase credits generated upstream from their facility. Credits will be created through voluntary reductions solicited through a request for proposal process. Farmers interested in participating in the trading program can submit proposals through their county SWCD. The WCS selects projects based on recommendations from an advisory group (with broad-based stakeholder participation), which will develop project criteria and review proposals. The WCS will then enter an agreement with the SWCD that submitted the proposal.

The number of credits generated by the various projects will be based on calculations made by the SWCD using a Load Reduction Spreadsheet, which is also used by other states and by the Ohio EPA and Ohio DNR. The SWCD that submitted the project proposal is responsible for periodic inspections of the project to ensure that it is functioning as designed. In addition, the program anticipates field testing –

[12] Information based on Hall, 2005; WCS, 2005a; WCS, 2005b; Kieser & Associates, 2004; and Breetz et al., 2004.

[13] An improvement of the Great Miami River watershed's water quality is also expected to contribute to improved conditions in the Ohio and Mississippi Rivers and the Gulf of Mexico, which suffers from hypoxia.

including water quality monitoring – at approximately 5 percent of the project sites every year. The monitoring results will be used to measure the performance of the BMPs and will provide data that will be used to verify and adjust, if necessary, the models in the Load Reduction Spreadsheet. To augment site-specific data, the program will also operate a water quality monitoring network that will continuously sample nutrients at four key locations in the watershed.

Projects are expected to be funded through contributions from the participating point sources, with additional funding coming from other sources such as the State Revolving Fund or grant money. The cost of credits is expected to be the sum of expenditures for all projects (including capital, operating, and maintenance costs, and any administrative costs incurred by the SWCDs) divided by the total number of credits created. Cost share dollars from other programs may be used to reduce water quality credit cost.

To sell the generated credits, the WCS enters into agreements with the eligible buyers who must (1) hold state-issued National Pollutant Discharge Elimination System (NPDES) permits, (2) have their NPDES permit modified to reflect participation in the trading program, and (3) participate in funding administrative and analytical cost of the trading program. Buyers are classified as either “Investors” or “Contributors.” This distinction is intended to promote early participation in the trading program. Investors are those credit buyers that participate in the trading program before they need to purchase credits to meet their NPDES permit requirements; Contributors are those buyers that join the program after their regulatory requirements take effect. Credit buyers are given an incentive to become Investors by being offered more favorable trading ratios (1:1 or 2:1, depending on location) than those that join as Contributors (2:1 or 3:1, depending on location). In addition to the type of buyer, trading ratios also differ depending on the water attainment status at the buyer’s discharge point: facilities located in impaired waters face higher trading ratios than facilities located in fully attaining waters. For example, an *Investor* discharging to *fully attaining waters* faces a trading ratio of 1:1, i.e., he must purchase one credit for each pound of discharge above the permitted limits. A *Contributor* discharging to *impaired waters* faces a trading ratio of 3:1, i.e., he must purchase three credits for each pound of discharge above the permitted limits. These ratios help further protect already impaired waters by insuring that there is a sufficient margin of safety. Some of the extra credits bought by contributors will be held in an Insurance Pool in case a BMP fails to produce the credits expected. Additionally, credits produced using the Section 319 NPS grant program may be deposited in the Insurance Pool. All Insurance Pool credits have a life of five years.

Thus far, the program is not yet up and running, so no credits have been traded. Once trading begins, participation in the program will be recorded in the buyers’ NPDES permits. Since all project credits are banked with the WCS, credit buyers are not liable for the success of specific offset projects. Rather, buyers receive credits in proportion to their contribution into the program fund (taking into consideration trading ratios). Collectively, the credit buyers are liable for the success of the offset projects. In the case of project failure, credits from the Insurance Pool would be used. If the Insurance Pool contains insufficient credits to cover the shortfall from project failure, buyers would have to contribute additional funds to implement additional projects. However, it is anticipated that the Insurance Pool could contain up to 100 percent of traded credits, making a shortfall very unlikely.

Based on an economic analysis of the likely viability of the trading program, the WCS expects a cost differential of up to 90 percent between the cost to buyers of reducing their nutrient discharges and the cost to sellers to provide offset credits. Coupled with the pending statewide nutrient standards for wastewater dischargers of 1 mg/L for total phosphorus and 10 mg/L for total nitrogen, this cost differential should provide a strong incentive for participation for both credit buyers and sellers.

A final aspect of the Great Miami trading program is its careful attention to social factors that might create barriers to program participation. For example, the program is set up to resemble, as much as possible, current cost share programs that are familiar to the agricultural community. If a project were to fail, the WCS anticipates that the responsible SWCD would work with the farmers to rectify the problem instead of resolving the issue through legal channels. The hope is to reduce fears in the agricultural community that program participation could have negative consequences for them – otherwise it is unlikely that farmers would participate in the program at all.

4.4 Kalamazoo River Water Quality Demonstration Project

The Kalamazoo watershed in Michigan covers over 2,000 square miles and has over 50 permitted PS dischargers. In 1996-97, the Kalamazoo River demonstration project was created to decrease NPS pollution, to establish a pilot trading program in Michigan, and to allow a paper company to increase its wasteload and thereby allow expanded production. The Steering Committee acted as a clearinghouse and was designed to facilitate trades of phosphorus credits from nonpoint sources to point sources. Trading ratios were used to account for uncertainty and ensure a net environmental benefit from each trade. The ratios could range from 2:1 to 4:1 for NPS-to-PS trades; the ratio for PS-to-PS trades was set at 1.1:1. Additionally, nonpoint sources would be paid for their phosphorus controls in three installments based on the progress of their implementation: 25 percent after agreeing on a plan, 50 percent after completion of controls, and 25 percent after controls prove to operate as originally intended.

It took nearly two years for the trading rules to be established, and there were also problems with identifying potential point and nonpoint sources, and with having sufficient staff to prevent slow implementation. Six NPS projects were implemented to generate credits, but no credits were sold because the paper company (one of the driving forces of the program) went out of business before the credits were complete. The few credits that had been created were retired in 2000 as the project came to an end.

Even if there had been sufficient demand for the credits, there were other complications with the program, such as getting nonpoint sources, particularly farmers, involved in the credit trading process. Farmers did not trust the regulators, were worried about being labeled polluters, and did not want their voluntary measures to be made mandatory. The Steering Committee was able to soothe some of their concerns by meeting face-to-face with farmers and by allowing the farmers to work with agricultural contacts that they knew and trusted. Additionally, farmers appeared indifferent as to whether they used a cost share subsidy program or this trading system (Breetz et al., 2004).

4.5 Long Island Sound

Long Island Sound (LIS) is a 1,320 square mile estuary that combines the drainage from a 16,820 square mile freshwater basin from New England with saltwater along the New York and Connecticut coasts (U.S. EPA, 2004). Each summer, the bottom waters in the western half of Long Island Sound experience hypoxia (i.e., very low levels of dissolved oxygen), which seriously impacts the local fish and shellfish populations. The main cause of this hypoxia is high levels of nitrogen, which fuel the growth of algae that will eventually consume large amounts of oxygen while decaying.

In April of 2001, EPA approved a TMDL for LIS, which would reduce nitrogen loading by 58.5 percent by 2014. Because most of the nitrogen control burden was expected to fall on the municipal sewage treatment plants (STP; nonpoint sources are also large contributors of nitrogen) the Connecticut State Legislature approved a Nitrogen Credit Exchange Program that was projected to potentially reduce the capital cost of nitrogen removal by $200 million (CT DEQ, 2001).

The Connecticut Department of Environmental Protection in collaboration with the Nitrogen Credit Advisory Board issued a general permit to the 79 STPs to ensure that they comply with the TMDL by establishing limits on their nitrogen discharges. The general permit also includes provisions requiring monitoring and reporting to ensure the proper accounting of nitrogen discharges. An "equalization factor" was also established by the general permit, which accounts for the different effects nitrogen discharges in different locations have on the dissolved oxygen demand in the western part of LIS.

A Clean Water Fund was established in Connecticut in 1986 to provide grants and low interest rate loans to municipalities for municipal wastewater treatment facilities. Projects designed to remove nitrogen are eligible for grants covering 30 percent of the costs and loans for the remaining 70 percent. When these nitrogen removal projects bring a facility's discharge below the General Permit level, the difference can be sold to other STPs as nitrogen credits. Nitrogen concentrations from each facility's discharge is monitored and then used to estimate the number of credits that are available for purchase based on their differences from baseline levels set by the TMDL.

All nitrogen removal projects for the year are used to calculate the price of the credits. The value of each credit is calculated by dividing the sum of the capital and operational costs associated with the construction of the nitrogen removal facilities by the total amount of nitrogen reduced by these projects. In 2003, 37 facilities were able to sell credits for $2.43 million while 40 facilities had to purchase credits for $2.12 million to meet their general permit (two facilities exactly meet their permitted levels). For 2003, the price of a nitrogen credit was $2.15 per pound (based on total cost of improvements divided by the number of nitrogen credits produced). All available nitrogen credits not purchased by STPs were then bought by the state of Connecticut (worth $311,761) using the Clean Water Fund. The most important factor limiting this program's success is the availability of Clean Water Fund financing to support these nitrogen removal projects (Breetz et al., 2004 and CT DEQ, 2004).

4.6 Tar-Pamlico Nutrient Reduction Trading Program

The Tar-Pamlico River basin is located in North Carolina and was designated a Nutrient Sensitive Water (NSW) in 1989 because of the increased frequency of fish kills and algal blooms caused by high nutrient levels. This NSW designation meant that the state needed to address nutrient levels in the basin, which resulted in a two-phase strategy.

The trade structure of the Tar-Pamlico trading program might most accurately be characterized as an exceedence tax. However, the program contains several bank-like elements that are of interest to this paper. The first phase of the strategy was to set up a pollutant trading system for point sources, who joined together with two environmental groups to form the Tar-Pamlico Basin Association. The Association proposed using a trading system rather than the traditional technology-based methods to control nitrogen and phosphorus discharges. The point sources agreed to either lower their nutrient discharges or fund agricultural BMPs through North Carolina's Agricultural Cost Share Program[14] in

[14] The North Carolina Agricultural Cost Share Program is a pre-existing program that provides farmers with funds to complete BMP. Farmers participate in this program voluntarily, and their interest in participating typically exceeds the cost share funds that are available (Breetz et al., 2004).

order to meet the annual collective loading cap. Additionally, the Association also agreed to develop a system to model water quality in the basin and to provide up-front funding for nonpoint sources to establish BMPs. This first phase lasted from 1990 to 1994 and resulted in the nutrient load meeting the decreasing nutrient cap each year. The point sources were able to meet this cap by reducing nitrogen and phosphorus discharges by 20 percent through improving treatment facilities' efficiencies (NCDWQ, 2002).

If the trading system (which the Association has not yet needed to meet their nutrient cap) were utilized, it would function as follows: NPS credits for nitrogen and phosphorus would be purchased from producers at a fixed per kilogram price, based on the capital and maintenance costs of the BMP, the area affected, and the BMP's expected lifespan and effectiveness. Those purchasing the credits from the Cost Share Program are faced with a 2.1:1 ratio, which includes a margin of safety and 10 percent for administrative costs. Once the point source has purchased credits from the Cost Share Program, it is no longer liable for those discharges. Instead, the State must monitor and verify that the BMP has been successfully completed. If the nonpoint sources are found to be noncompliant they must return the Cost Share funds they received to complete the BMP. The North Carolina Division of Water Quality, the regulatory authority responsible for overseeing the trading program, ultimately gives approval for the pollutant allocations and any trades that may occur (Breetz et al., 2004).

Case Studies of Water Quality Trading Programs with Bank-like Features*						
Program Characteristics	**Chatfield Reservoir, CO**	**Cherry Creek, CO**	**Great Miami River Basin, OH**	**Kalamazoo River, MI**	**Long Island Sound, CT**	**Tar-Pamlico Basin, NC**
Bank Administrator	Chatfield Watershed Authority	Cherry Creek Basin Water Quality Authority	Water Conservation Subdistrict of the Miami Conservancy District	Steering Committee	Connecticut Department of Environmental Protection & Nitrogen Credit Advisory Board	North Carolina Division of Soil and Water Conservation's Cost Share Program
Bank Type	Public and Private Collaboration	Public and Private Collaboration	Government Collaboration	Public and Private Collaboration	Public and Private Collaboration	Government
Spatial Coverage of Bank	Watershed; 3,000 sq mi	Watershed; 380 sq mi	Watershed; 4,000 sq mi	Watershed; 2,000 sq mi	Estuary; 1,320 sq mi	Basin; 11,650 sq km
Pollutant(s) Traded	Phosphorus	Phosphorus	Nitrogen & Phosphorus	Phosphorus	Nitrogen	Nitrogen & Phosphorus
Point Source to Point Source Trades	Yes	Yes	No	Yes	Yes	Yes
Point Source to Nonpoint Source Trades	Yes	Yes	Yes	Yes	Yes	Yes
Source of Capitalized Fund	-	Property taxes and user fees	PS contributions, Ohio's State Revolving Fund, other grants	Grants and PS contributions	Clean Water Fund	PS contributions
Incorporation into Pre-existing Programs	No	No	Ohio's State Revolving Fund	No	Clean Water Fund	NC's Agricultural Cost Share Program
Do Individual Trades Need Approval?	Yes	Yes	Yes	Yes (Credit production needs approval); (Not yet determined for credit purchases)	No (Procedures in General Permit must be followed)	No (PS to PS) Yes (PS to NPS)
Monitoring and Maintenance Responsibility	Bank monitors water quality	Bank monitors water quality	Soil and Water Conservation District monitors % of sites and general water quality	Monitoring done by outside agencies	PS must monitor and report their discharges	PS to PS monitor themselves; state responsible for monitoring BMP
Regulatory Driver for Participation	TMAL	TMAL	Statewide nutrient criteria	Anticipated TMDL	TMDL	TMDL

Case Studies of Water Quality Trading Programs with Bank-like Features*

Program Characteristics	Chatfield Reservoir, CO	Cherry Creek, CO	Great Miami River Basin, OH	Kalamazoo River, MI	Long Island Sound, CT	Tar-Pamlico Basin, NC
Number of Trades	1	3	N/A	Credits produced but never purchased	Many (PS to PS) None (PS to NPS)	Many (PS to PS); None (PS to NPS)
Problems with Participation	Lack of need for credits; problems finding funding for NPS projects	Need to encourage trading as a way to meet short-term water quality goals	N/A	Farmers were initially reluctant; the driving force, a PS in need of credits, closed	PS have been able to meet General Permit limits without NPS trading	PS have been able to meet group cap without NPS trading
Trading Ratios Used**	2:1	2:1 to 3:1	1:1 to 3:1	1.1:1 to 4:1	"equivalency factor"	2.1:1
Price Paid to Credit Producers	-	-	BMP cost	BMP cost	Cost of nitrogen credit generating projects	BMP cost
Price Paid to Credit Bank	Based on NPS project costs, trading program costs, and PS contributions	Base price used to ensure that sufficient funds are available for completion of equivalent project	Average BMP cost/lbs reduced	N/A	$2.15/credit Cost of credit generation divided by number of pounds of nitrogen removed	$56/kg Based on average BMP cost in neighboring watershed, including safety factor***
Administrative Costs	$100 fee	Covered by property taxes and user fees ($500-$2,500)	PS will cover costs with money saved due to trading	Using outside agencies helped reduce costs	Very Limited	10% - included in ratio
Additional Notes	N/A	Trades will likely increase as the population in the area increases	The program has not yet started.	A demonstration project that ended in 2000	General permit given to 79 STPs; no NPS have participated in trading	PS to NPS trades are more akin to an exceedance tax than a trading program

* "-" indicates that information was not readily available.
** "trading ratios" is used as a generic term for all adjustments applied to the number of credits bought and sold based on variability in the location, reliability, etc. of the credits.
*** (Jacobson, Danielson, and Hoag, 1996)

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