Delaware County Action Plan
DCAP II
for Watershed Protection and Economic Vitality

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Delaware County thanks all who contributed to this revision of DCAP

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DCAP: Executive Summary

Under Section 18-83 of the Rules and Regulations for the Protection from Contamination, Degradation and Pollution of the New York City Water Supply and its Sources a Comprehensive Strategy was developed to meet the needs of the county as a result of the Cannonsville Basin being designated a phosphorus-restricted basin. The Delaware County Action Plan (DCAP) is that comprehensive strategy.

DCAP Mission: To assist the county's residents, farmers, businesses, and communities in meeting water quality parameters and objectives without loss of opportunities for economic vitality.

Specific Goals: To successfully accomplish that mission, two specific water quality goals were identified. These objectives are:

1. Institute specific contaminant reductions for individual management sources of the contaminants;
2. Meet overall basin level goals of contaminant load reductions such as the operational goal of reducing phosphorus by 10,000 kg/year.

DCAP Management Components: To reduce pollutant loads associated with phosphorus, pathogens and other contaminants, DCAP addresses the management needs of the following components:

- Basinwide stormwater and drainage management
- Comprehensive precision farm nutrient management
- Improving septic systems and septage disposal
- Erosion control and phosphorus reduction through stream corridor protection and rehabilitation

Note: *DCAP assesses and determines the management needs of these components comprehensively within their basin-wide context*

DCAP Institutional and Operational Procedures: There are five key features:

1. DCAP establishes and is based upon a credible and sound scientific foundation.
2. Planning, management and evaluation depend upon sound quantification using extensive monitoring and modeling.
3. It is conducted cooperatively with the partners to the MOA, complements and enhances other watershed programs, and is transferable to other watersheds.
4. DCAP is locally led and has developed county based technical capacities.
5. Within the terms of the Memorandum of Agreement (MOA), fosters voluntary participation and management by local governments, landowners, residents, and businesses.

Accomplishments to-date:

- DCAP has completed a comprehensive quantified assessment of the Cannonsville Reservoir Basin.
- DCAP has established an operational goal of reducing phosphorus by 10,000 kg/year.
- Through work associated with DCAP and other sources, DCAP has identified agriculture as the most significant source of phosphorus.
- A management plan for each of DCAP's components is now being developed and implemented.

DCAP is demonstrating that a locally led watershed program is economically frugal and comprehensively effective in protecting water quality.

I. Introduction

Delaware County has great natural beauty and resources, with a rich heritage and culture. Its attractions make it an appealing location in which to live and work. It also has fine recreational amenities. It was the pristine waters that attracted the City of New York to view the Catskills, and Delaware County in particular, when searching for water to quench the ever growing thirst of its residents. Years passed, and presently watershed towns now must meet water quality standards in an effort to maintain the high quality water supply that New York City is accustomed to.

The protection and enhancement of water quality in the New York City Watershed depends upon the cooperation and efforts of the communities and residents of the watershed. Under the Surface Water Treatment Rule (SWTR) of the Safe Drinking Water Act (SDWA), to avoid filtration requires that the "public water system must demonstrate through ownership and/or written agreements with landowners within the watershed that it can control all human activities" (Federal Register 2000). The New York City Watershed Memorandum of Agreement (MOA) provided that control and is the mechanism that allowed the United States Environmental Protection Agency (EPA) to grant a Filtration Avoidance Determination (FAD). Involvement of local stakeholders in meeting the TMDL requirements of the Clean Water Act is also a necessity recognized by EPA. Therefore, under both the Safe Drinking Water Act and Clean Water Act, local agencies and communities have a significant role in watershed protection.

Under the New York City watershed regulations, Delaware County was faced with a prohibition on the expansion or building of new Waste Water Treatment Plants (WWTP) with surface discharges in the Cannonsville Basin of the New York City watershed. This prohibition created a clearly negative impact on economic vitality and opportunities for growth.

The negative economic consequence of the regulations on a major section of Delaware County, created the circumstances under which the county was compelled to take action under one of the variance provisions for its own economic well-being. The county chose Section 18-83 of the New York City Watershed Regulations as it provides for new WWTPs or the expansion of an existing WWTP. As a practical matter, only by complying with Section 18-83 can the county create the most flexibility in complying with the regulations in a phosphorus-restricted basin, protect water quality, and address its economic objectives. Under section 18-83 a Comprehensive Strategy is required in a phosphorus-restricted basin. The DCAP is that comprehensive strategy. While the greatest water quality challenges face the Cannonsville Reservoir basin due to its designation as a phosphorus-restricted basin, there are parallel needs and opportunities elsewhere in the Delaware and Susquehanna watersheds. Indeed, it appears appropriate to consider opportunities for a County-wide DCAP and for possible advantages in sharing regional interests.

This is the first revision of the DCAP. The DCAP is an evolving program and this revision reflects the changes made, achievements of this writing and recommendations for the near future. The DCAP reflects the efforts of many watershed partners and Delaware County is thankful for the continuing commitment of its partners to implement DCAP. DCAP is consistent with the spirit of the MOA and other watershed programs that advocate

the importance of maintaining and enhancing water quality, economic vitality and the social character of the watershed.

II. New York City Watershed Objectives

The overriding objective of the New York City rules and regulations, and watershed protection programs is to protect public health by providing safe drinking water to over nine million residents in and around New York City as required under the SDWA - SWTR.

In the landmark MOA between New York City and upstate communities it is recognized that "the goals of drinking water protection and economic vitality within the Watershed communities are not inconsistent". The parties further declared to "cooperate in the development and implementation of a Watershed Protection program that maintains and enhances the quality of the New York City drinking water supply system and the economic vitality and social character of the Watershed communities" (MOA 1997).

The DCAP mission and objectives are consistent and compatible with the protection of public health and enhancing the local economic vitality and social character.

III. DCAP Mission, General Goals, Specific Goals and Time Frame

A. DCAP Mission

The mission of DCAP is to assist the county's residents, farmers, businesses, and communities in meeting water quality standards and objectives without loss of economic vitality.

B. General Goals

1. To reduce phosphorus loading to, and phosphorus concentrations in, the Cannonsville reservoir to improve water quality and for relief from the phosphorus restrictions.

2. To establish and sustain DCAP as a watershed management program to ensure that the Cannonsville remains below phosphorus regulatory thresholds.

3. Provide technical resources and information to assist community leaders in sustaining home rule related to water quality, economic and social concerns affecting the community and the water supply.

4. To assist the non-regulated community in reducing NPS phosphorus loading.

C. Specific Goals

There are two specific goals necessary for successfully meeting the operational goals of DCAP:

1. Institute specific contaminant reductions for individual management sources of the contaminants;

2. Meet overall basin level goals of contaminant load reductions such as the operational goal of reducing phosphorus by 10,000 kg/year.

- Delaware County developed benchmark operational goals for phosphorus reduction to guide decision-making. The average load of phosphorus (P) from non-point sources to Cannonsville from entire basin (including Trout Creek) in "typical" loading years is approximately 48,000 kilograms per year. Based on current estimates of phosphorus loads, the interim reduction goal is 10,000 kilograms or approximately 20% of the overall phosphorous load. An explanation is provided under Appendix A of this document as to how this goal was developed.

D. Time Frame for Implementation

DCAP implementation began in 1999 and will continue for the foreseeable future. Implementation is dependent upon such factors as funding, personnel, contractors and community and county resources. The preferred implementation process is priority based.

IV. DCAP Management Components:

Management components outlined below reflect the tasks necessary to accomplish our mission, and general and specific goals.

A. MOA Context of Components

Contamination of drinking water supply may result in serious public health implications, and thus source water should be protected from pollution and therefore degradation. This fact becomes of particular importance in the New York City watershed, where unfiltered surface water, supplied by the upstate reservoirs, is provided to the 9 million residents of New York City and its suburbs. Various strategies must be implemented to ensure public health safety and drinking water quality protection.

In order to comply with the Watershed Rules and Regulations and to prevent the contamination of its reservoirs, while ensuring the economic viability of the region, the Delaware County developed its Action Plan (DCAP). This Program concentrates mostly on source water protection through control of and reduction in non-point sources of pollution (i.e. phosphorus, sediments and pathogens).

Since the Cannonsville Reservoir basin is classified as phosphorus restricted, a lot of emphasis in DCAP is given to the best management practices, which reduce phosphorus loading to this reservoir. Phosphorus has been identified in the watershed as a limiting nutrient, and an enrichment of the reservoir with this nutrient causes its eutrophication, with subsequent algae blooms and enhanced production of natural organic matter. The latter then reacts with disinfectants to form a broad class of disinfection byproducts (DBPs), some of which have been reported to cause serious detrimental health effects. Algae blooms also contribute to the increased particulate matter content, which in turn,

undermines the efficiency of disinfection. In addition, in many instances sources of phosphorus also represent the sources of pathogens, and thus reduction in phosphorus load may consequently result in pathogen reduction.

1. Phosphorus accounting

Accounting for Phosphorus Loading Reduction: The MOA provides for a pilot offset trading program for phosphorus, in which certain phosphorus reductions may be created and counted to offset increases in wastewater discharges to surface water. Although this provision may be further explored through the DCAP, the challenges it provides indicates that this may not be the favored option for the long run.

A preferable solution appears to be to achieve a favorable basin-wide phosphorus balance through aggregated phosphorus reductions, there by allowing for a prosperous local economy while protecting water quality. However, it will constitute a scientific and administrative challenge to account for non-point source phosphorus reductions as they are implemented. Unfortunately, it is likely to be many years before water quality sampling validates with complete confidence the effectiveness of the reductions through measured gains in water quality in the reservoir. Therefore, Delaware County has developed a surrogate scientific technique to measure the effectiveness of its DCAP as a basis for current management steps so the county does not depend upon and need not await future water quality sampling results. It is important to note that such estimated measures are not intended to serve as replacements for observed water quality in the reservoir. Rather the measures will guide decision making and management for point and non-point sources. By this procedure, the lag between land management and measurable effects on water quality will not defeat the necessity for immediate management decisions. The observed and estimated effectiveness by which reductions in phosphorus are accumulated will also expedite making desirable iterative adjustments in management decisions and policies over time.

From the perspective of the watershed communities the offset options direct very limited time and resources in communities, where only small amounts of phosphorus runoff are produced, to an administrative process that does very little to reduce phosphorus, is difficult to administer, implement, and handcuffs communities when opportunity for economic vitality comes to the forefront. Although intended to provide options to communities, when discussed at the local level the offset programs are perceived to serve no purpose other to regulate for the sake of regulation. The process, protocol and time frame for acquiring an offset is not readily clear to watershed communities. As understood today, it could take 18 months to obtain approval on an offset pre-application. This uncertainty is not compatible to businesses that may wish to expand or establish themselves in the watershed in a timely fashion and obviously can put them and the region at a competitive disadvantage. We propose a concerted effort by watershed partners to reduce non-point source phosphorus as a much more constructive and productive pursuit for water quality than that of offsets. In the interim we propose that a dialogue begin to clarify and streamline the offset process. In light of the time-lapse between implementation of Non -
Point Source (NPS) practices and resulting improvements to water quality below current regulatory thresholds the offset options are an important tool that should be improved.

2. Multiple barrier approach to risk reduction

Under DCAP we have adopted a multibarrier approach to addressing potential pollutants. The barriers utilized are, the Initial Source Barrier, the Transport Barrier and the Stream Corridor Barrier.

The concept of barriers used in DCAP is equivalent to that used in the NYC Watershed Agricultural Program, which itself was inspired by an analogous concept in water supply regulation. A "barrier" is a deliberate pollution prevention or control measure between an original pollutant source and a location where pollutants can cause harm. In the US, water supply consumers are protected from pollutant sources via one or more of three "barriers": watershed protection, filtration, and disinfection. These work in series -- a pollutant which evades a watershed protection barrier may still be trapped or destroyed by a later, second or third barrier. DCAP's barrier concept applies between pollutant sources and stream channels. The *Initial Source* barrier attempts to prevent a pollutant from being introduced into the environment in the first place. This may mean complete containment or it may mean having people and their sources generate less of the pollutant in the watershed. The *Transport* barrier attempts to impede the movement of a pollutant within the environment. For example this could be a stormwater treatment system that removes pollutants before stormwater enters a stream. The *Stream Corridor* barrier attempts to remove pollutants at the edge of the stream. A riparian forest buffer is a classic example.

B. Stormwater and Drainage Management

DCAP continues to develop its comprehensive approach to stormwater management. For ease in expressing our approach this section is presented as Community Stormwater and, Highways and Stormwater for planning and implementation. A third section contains our research, monitoring modeling and evaluation needs of stormwater management in the basin.

By far the greatest load of phosphorus and other contaminants is transported to the reservoir during periods of high flows. Treatment of stormwater, and reduction of peak flows during floods, may offer substantial benefits in phosphorus reductions. Stormwater and flood management systems also offer significant collateral economic benefits especially if incorporated in a wider economic revitalization program. Such benefits include: the direct funding support provided to the business or municipality to implement the systems, landscaping projects, a main street revitalization projects undertaken in conjunction with the creation of the infrastructure required for stormwater or flood management. Stormwater management strengthens the Transport barrier and may contribute to the Stream Corridor barrier.

Photo courtesy of the Department of Economic Development

1. Community stormwater

Goals**:**

- The county seeks to be part of the dialogue with the New York City Department of Environmental Protection (DEP) and the New York State Department of Environmental Conservation (DEC) for overall administrative procedures, guidance, and prior acceptance of technical standards and specifications adopted under flexible regulatory rules. We seek inclusion in the regulatory negotiations for establishing standards for performance standards and BMP standards.

- To assist small businesses and residential owners in identifying non-complying regulated activities (NCRA) and assisting them with the registration process of the Non-complying Regulated Activities Program.

- Support communities in the Cannonsville Basin. Continue to identify and adopt stormwater pollution prevention measures and specifications that can be used with existing structures or impervious surfaces in village centers and hamlets to reduce phosphorus and improve stormwater management.

- Assist communities who wish to develop a Stormwater Protection Plan for the purposes of acquiring a waiver from Section 18-39 of the rules and regulations.

- Complete a community by community assessment of stormwater management needs and opportunities. This is underway. The assessment provides information regarding: existing stormwater systems, identification of point source discharges of stormwater, identification and stormwater yield calculations of community's sub-basins, opportunities for identifying and promoting large scale municipal stormwater projects as a basis for 'main street revitalization' projects.

- Assess and apply options for the creation of amenities (such as landscape designs incorporated into the projects) or other benefits potentially available to businesses and communities in developing the stormwater/flood management projects.

- The maintenance of the BMPs will be based on a maintenance schedule developed by the Planning Department derived from the GPS and GIS work begun in 2001. Additionally, the county through a combination of grants and the local tax levy has purchased a vacuum truck to maintain these and other stormwater practices where possible.

2. Highways & stormwater

Road design, condition and maintenance have a bearing on the potential pollutant load originating from the roads in the Cannonsville Basin. Road maintenance practices, such as the application of sand, cinders and salt for public safety and the cleaning of ditches to ensure proper drainage create opportunities for accumulation and transport of sediment and pollutant loads to adjacent water courses. It is recognized that roads and the associated stormwater structures also serve as a conduit of pollutant delivery originating from contiguous land uses.

Phosphorus loading from the different road surfaces is estimated at approximately 3,911 kg/yr of total phosphorus of which 1,737 kg/yr is in the form of dissolved phosphorus (McIntyre 2001). This represents less than ten percent of the total load but is still a significant source of phosphorus to address due to the phosphorus restriction.

Depending upon funding, an in-depth evaluation, pollutant loading calculation, and recommended Stormwater Management Practice (SMP) designs and maintenance procedures will be provided for several characteristically "critical" roadways, with the results of this work shared with local highway superintendents, town supervisors, local, state, and federal agencies that effect highway design, construction, and maintenance. The long-term steps are outlined below:

- Inventory/Assessment

  The Delaware County Department of Public Works (DPW) has already completed an inventory, assessment and priority list for the county highways. Contingent upon available funding, the DPW will now begin conducting the same for towns that would like to participate. Resultant county and town data will be converted and stored in the county GIS database. The long term goal of this process will be a Highway Management Plan (HMP). The HMP is an inventory of all roads and stormwater structures within a town, an analysis of the condition of the road and accompanying stormwater appliances and watercourse crossing structures, prioritized list of roads to be addressed and recommendations as to how best address any substandard conditions.

- Municipal Plan Development

  At the conclusion of a HMP for each town or respective county highway, the DPW, contingent upon funding, will develop a ten-year plan for each town and county highway that identifies and prioritizes areas for implementation of SMPs.

With limited resources it is only prudent to develop a comprehensive plan for identified priority areas.

- Maintenance of Current Road System

  Maintenance of roads includes the application of materials for public safety including sand, cinders and salt. Sand, for example, accumulates in the culvert and requires maintenance removal every few years. The removal results in dislocation of the soil and the potential for erosion. An assessment of alternative means of road maintenance and ice and snow removal is ongoing**.**

- Roads as Conduits of Pollutant Delivery

  Delaware County intends to integrate the planning process with town/village roads. Delaware County will conduct planning with the use of the spatially distributed model under development as part of DCAP for identifying priority areas within the Cannonsville watershed. Highways are conduits for stormwater drainage for or to surrounding land. This will complement the HMP Program.

- Local Capacity Building

  It will be necessary to develop institutional arrangements and capacity within towns to assess potential load reductions from town roads and provide training to Town Highway Superintendents on road maintenance. The DPW will utilize the GIS database and relevant modeling methods to assist in the assessment of potential load reductions. Equally important will be the development of a program to work with towns to address phosphorus management on their roads and implement SMPs. Since town roads represent the largest surface area of roads in the Cannonsville Basin, this element is essential to the success of the program. Again, this is a complementary component to the HMP Program.

- Implementation of Pilot SMPs

  As an initial effort, Delaware County would like to install SMPs identified through the HMP program in areas in close proximity to the reservoir and streams that have an obvious potential for contributing to the phosphorus load in the reservoir. These pilot projects would include the development of monitoring sites to evaluate of the impact of the SMP. The DPW with the assistance of the Planning Department, will input the monitoring data into the county GIS database. Relevant modeling methods will be used to assess the impact of the SMP. These projects will serve as a learning tool for customizing the SMPs for the roads in Delaware County.

3. The scientific needs for stormwater management

- Characterize and quantify the contributions from various types of stormwater runoff urban/impervious sources, such as storage facilities, parking lots, dirt roads, and highways, in the Cannonsville Reservoir basin as a basis for planning and designing projects. An important concern is the extent to which stormwater runoff is a source of not only phosphorus, but also pathogens.

- Continue work underway to determine relationships between main categories of urban/impervious areas and the quantity and quality of

runoff/stormwater/floodwaters generated by such land uses in the basin to establish guidelines.

- Continue work ongoing to establish the scientific basis for developing comprehensive village stormwater projects.

- Identify and adopt specific BMPs in impervious areas/stormwater projects according to appropriate quantified design criteria. Bovina, Walton, Delhi and the municipal solid waste facility are examples of where this has been done.

- Critically examine the efficacy and applicability of BMPs to provide treatment to reduce both particulate and dissolved phosphorus so these reductions can be documented as progress towards the desired favorable phosphorus balance in the basin. Funding has been received to construct stormwater BMPs that hold potential as offsets at WWTPs. The county is currently seeking funding to monitor the BMPs. A critical need is to establish a consistent administrative protocol for collection, analysis and then documentation of the reductions with DEP for expansion at WWTPs.

- Assess benefits of the phosphorus controls applied in reducing other contaminants that would otherwise affect water quality of the reservoir. The County Scientific Support Group (CSSG) has discussed this.

- Assess best management options for attenuating and retarding floodwaters to reduce phosphorus and other contaminant loadings and explore incorporating such measures in selected projects. Integrate stormwater and flood management within the proposed comprehensive stream corridor management program for the Delaware West Branch system to obtain extra protection from pollution at the stream corridor.

- Develop and make readily available the scientific rationale and evaluation of each project as it is developed, implemented and demonstrated.

Recommendation: Secure funding for planning, implementation, monitoring and scientific efforts from the Catskill Watershed Corporation, federal, state and local sources.

C. Nutrient Management

The use of acronyms runs rampant regarding nutrient management and causes confusion so the definition of three acronyms are outlined below to alleviate confusion with DCAP efforts and the corresponding support of the nutrient management team from Cornell.

1. CFNMS = Comprehensive Farm Nutrient Management System. Our view is that it represents a more holistic systematic approach to nutrient management that we use in this document. It is our opinion that it represents a new standard for nutrient management.

2. CUNMPS = Cornell University Nutrient Management Plan System. Essentially this is the same as the CFNMS. For the purposes of this document we use CFNMS to avoid confusion with third acronym below. The CUNMPS is only used in the component

section entitled: "Scientific Development and Support for Comprehensive Farm Nutrient Management Systems." Portions of that text are authored by Professor Dan Fox, of Cornell, the architect of CUNMPS and cuNMPs and we present his text as written.

3. cuNMPs = Cornell University Nutrient Management Plan Software. This integrated software package ties together the components of the CFNMS.

A history of phosphorus accumulation in agriculture

Agriculture has been identified as the largest source of phosphorus loading in the Cannonsville Basin. Delaware County farmers have a strong ***documented*** stewardship record with regard to implementing conservation practices. Clearly farmers have not purposely created a problem, so why and how has this come about?

There are a variety of reasons that help explain how this has transpired. It is important to note that the history of accumulation on the farm is a long one, complex and the solutions to reverse the status are not immediate. Most, if not all, are unintended consequences of economic survivability in highly competitive industry. Productivity gains in agriculture equal or exceed those of any industry. In fact, the genetic potential of many dairy cattle exceed the ability to meet all their nutrient requirements in early stages of milk production. The increases in productivity and efficiencies was and is driven by consumer demand for cheap food and subsequent federal policies that support that demand. In the past, the federal government subsidized the application of phosphorus on the land to increase crop productivity. This helps explain why years later idled farmland may still be a source of phosphorus. The increases in productivity of dairy cattle, noted above, resulted the need for increased purchases of grain from outside the region to support increasing milk production. The imported grains used to meet nutrient requirements can contain far more phosphorus than is needed for both milk production and crop production. The net result is accumulation on farms and a larger pool of phosphorus that can release from farms in runoff. An additional reason for accumulation is that farmers have traditionally balanced their crop's nutrient needs based on its nitrogen and not phosphorus requirements. Mass Balance on dairy farms illustrates the accumulation of P on farms. This is common throughout the northeast and farms in the Cannonsville Basin are consistent with this. Mass balance for phosphorus has shown that approximately 70-80 percent of the annual phosphorus inputs remain on the farm. This issue was clearly understood in the Ad Hoc Task Force Discussions on Agriculture in the New York City watershed (1991). These negotiations led to the formation of the Watershed Agriculture Program (WAP). Adding to the problem is a belief that still exists on some farms that extra phosphorus be fed as insurance to assure successful reproductive performance. Fortunately, there are viable options that can help mitigate the challenge of phosphorus reduction.

General agriculture objectives

Agriculture is a very important industry in Delaware County. The DCAP recognizes this and developed initiatives to, at minimum, sustain agriculture and hopefully enhance its

value while addressing water quality concerns. Dairy farming constitutes approximately 80% of agricultural sales in Delaware County. Our estimates show that Delaware County farms represent 80% of the dairy farms in the New York City watershed area. The Cannonsville Basin contains approximately 80% of all dairy farms in the NYC watershed.

DCAP goals focus on large pools of phosphorus where opportunities for broad phosphorus reductions exist that lead to relief from the phosphorus restriction and may hold potential for offsets. DCAP initiatives for agriculture originated over concerns in the Cannonsville basin but are developed with the entire county in mind. DCAP initiatives for agriculture are voluntary, incentive based (where possible), locally administered and ultimately can benefit farmers with minimal interference in the farm operation while providing technical support and reducing nutrient and pathogen loading. How we address this is discussed later.

Institutional overview

The DCAP framework for addressing agriculture phosphorus issues is highly integrated. The county is looking to Cornell Cooperative Extension staff of Delaware County to develop the integration of multiple components with Cornell University faculty
and presumes a partnership with the Watershed Agricultural Program (WAP) to implement some components.

The Watershed Agricultural Program (WAP) is a New York City funded program established for the delivery of water quality practices on farms for the protection of the New York City water supply. The Watershed Agriculture Council (WAC) is the governing body of the WAP program composed of farmers, local agribusinesses and DEP. The WAC subcontracts with Delaware County agencies, the Soil and Water Conservation District (SWCD), Cornell Cooperative Extension of Delaware County (CCE/DC) and the USDA/Natural Resources Conservation Service (NRCS) for the technical, administrative and subject matter expertise to develop and implement whole farm plans including the design, engineering and implementation of best management practices and they represent the necessary partners in the WAP. The WAC's primary water quality objective is directed towards pathogen management.

Despite the many successes achieved by the WAP regarding nutrient management to date it has not addressed the long term accumulation of nutrients on farms, especially phosphorus. Such accumulation of nutrient is as the root of the nutrient management challenge in the northeast dairy industry, and especially in the Cannonsville Reservoir basin. Through the development of a Comprehensive Farm Nutrient Management System (CFNMS) we intend to raise the standard for CFNMS. Currently, in the New York City watershed, nutrient management plans are being conducted at the same standard as every place else in New York State. We suggest here that integrating the work of DCAP and WAP that the standard can be raised for one of the most critical water supplies, in the United States. These combined efforts can set the stage for continued voluntary approach to nutrient management.

Having said this, it is important to recognize that the WAP has set as a goal to implementation Comprehensive Nutrient Management Plans (CNMP), (NRCS 590), on

90% of its farms using the Cornell University Nutrient Management Planning software (cuNMPS) - Cropware. In April of 2002 the WAC adopted a policy that addresses the importation of surplus phosphorus in purchased concentrates and mineral supplements. Also structural BMPs have been implemented that will have a positive impact on P loading. For example, recent work conducted by United States Department of Agriculture - Agriculture Research Service (ARS) on Town Brook concluded that milk house filter strips are effective

year round (Gburek 2001). This is a highly soluble form of phosphorus that can now effectively be kept out of streams. However, balancing for phosphorus on crops is the largest challenge and will not become a viable possibility unless combined with the forage systems, manure management on and off farm and also linked to the adoption of precision feeding on the farm. We refer to this as the Comprehensive Farm Nutrient Management System (CFNMS).

CFNMS components

Continuing work under DCAP demonstrates the application of the *cu*NMPS significantly reduces imports of phosphorus and nitrogen to the farm by 25 percent or more. This remarkable management result is achieved by using CFNMS. The *cu*NMPS software for precision feeding methods in conjunction with improved manure nutrient management and forage production on the farm fosters efficient recycling of nutrients in the soil, and diminishes losses of the nutrients to watercourses. Improved forage management also reduces the need for imports of nutrients to the farm. Finally, by avoiding excess applications of nutrients in manure, or by not applying manure on frozen soil, or in other hydrologically sensitive areas, farmers can further reduce very significantly reduce the risk of losses of nitrates, total and dissolved phosphorus, and pathogens, to watercourses. The CFNMS can also provide significant economic benefit to the farmer. Cumulative benefits can greatly reduce levels of phosphorus and nitrogen in drainage water
and runoff from the farm thereby achieving pollution prevention combined and may provide economic gains for the farmer.

As the cuNMPS software supporting precision feeding, forage systems management and manure nutrient management is being developed at Cornell University, it is proposed that Cornell Cooperative Extension staff in partnership with Cornell University faculty develop the CFNMS and lead the development of the cuNMPS software and provide training to Whole Farm Planners within the WAP program to integrate whole farm forage systems management planning with the current manure nutrient management planning underway in the WAP.

Components of CFNMS:

1. Reducing the import of nutrients to the farm through precision feeding.
2. Enhancing the recycling and re-use of phosphorus and nitrogen on the farm through comprehensive farm forage system management.
3. Avoiding excess applications of phosphorus and nitrogen in manure to farm fields through manure management.
4. Ongoing scientific development.

1. Reducing the import of nutrients to the farm through precision feeding

Objective: To reduce phosphorus excretion through the reduction of phosphorus purchases in the form of mineral supplements and purchased concentrates. This directly reduces the Initial Source leading to an improvement of the mass nutrient balance on farms and reduced phosphorus accumulation on the farm.

The proposed precision feeding program will build upon the experiences in this area under the DCAP Phosphorus Reduction Through Precision Feeding Program – Project 1 initiated in 1999 in the Cannonsville basin. The program will focus on reducing nutrient

imports on to dairy farms by reducing purchased feed imports and utilizing more homegrown nutrients in the dairy diet. The proposed program will seek however, to work more closely with the feed industry and will retain the feed industry's present role as herd nutritionist in making dietary changes. The results of this work primarily serve the long term objective of reducing phosphorus concentrations and total P load below regulatory thresholds in the Cannonsville reservoir. This project will provide the technical, scientific and practical basis to ensure confident adoption and implementation by farms and dairy nutritionists of precision feeding principles on farms across Delaware County, the surrounding region and the recently adopted WAC policy. The project will also be done in cooperation with the AEM program.

Program and results: Currently four farms in the Cannonsville Basin continue to cooperate in developing an implementation, demonstration/education and applied research project to document the effectiveness of this approach. The work is being conducted by CCE/DC in cooperation with Cornell under the New York State Agriculture Environmental Management (AEM) umbrella. Data is collected and analyzed with regard to phosphorus content of forages produced on the farm. The forage contribution to the diet is balanced with purchased concentrates to meet the requirements of the dairy cows.

The results are impressive, this project demonstrates that phosphorus excretion can be reduced 25% or more without affecting production. This is accomplished through reduced mineral supplementation and/or reduced phosphorus concentration in the purchased grains. These results are quantified and have been implemented on dairy farms.

Recommendations: Currently the project involves four farms. We recommend that project be expanded to 10 or more farms broadening the scope of demonstration. This does two things. First, the implementation and acceptance of this approach would be enhanced by a larger number of farmers participating. Second, also it would involve a broader audience of private sector of feed companies and dairy nutrition consultants. We recommend a three year program for this project to adequately transition into the private sector. It is the norm to have the feed industry provide dairy nutrition services to the farm community, as it requires more frequent interaction with the farmers than the public sector can provide. It is also the norm for Cornell Cooperative Extension staff to bring land grant information to the private sector for adoption. Delaware County recently received a Watershed Enhancement Assistant Program (WEAP) grant to pursue this work.

The proposed program will facilitate the feed industry in this role by assisting in the gathering of farm data, providing feed analysis, and provide nutritional consultation and training when needed. In addition to these roles, the program will document P reductions achieved on farms, facilitate the development and implementation of the reduced dietary P strategies on farms, and continue to develop and augment usage of the Cornell Net Carbohydrate and Protein System (CNCPS), the dairy cattle management software component of the cuNMPS. Additionally the program will, as part of its research and development focus, explore and develop new and emerging precision feeding initiatives, such as a dairy herd replacement precision feeding program.

The program is organized around a core staff of a Precision Feed Specialist and technician(s). These personnel will be employed through CCE/DC. The number of technicians will vary according to the number of farms under taken in the project (1 technician per 20 farms), which will in turn be a function of the availability of funding resources. Cornell University staff in the Department of Animal Science will be employed in the development and usage of the CNCPS in coordination with the watershed based staff.

It is proposed that the program be implemented in phases, with the first phase consisting of a pilot phase to further refine the precision feeding process as it engages the feed industry and more farms in the NYC watershed. This pilot phase would initiate with a minimum of 10 farms and function over a 3 year period. The delivery of this program should carried out in collaboration with the WAP educational efforts.

It is anticipated that knowledge acquired in this effort will eventually be a standard component of balancing rations on farms and may yield economic benefits on some farms depending on changes that may be made in the current feeding regime. The net result of implementation is a neutral or positive impact on farm finances.

The proposed program can be summarized as follows.

1. Engages feed industry in their current ration balancing role with their clients.
2. Employs CCE/DC dairy specialist to manage program and work with feed industry in implementing P reduced rations.
3. Employs technician(s) to work with specialist and feed industry in gathering data on farms.
4. Employs Cornell University to further develop, test and train feed industry on CNCPS software.
5. Begin implementation with a pilot program involving 8-12 farms.
6. Development of further precision initiatives such as a dairy herd replacement program.
7. This program would eventually be extended to more farms in the basin following modification of the process as developed in the pilot implementation phase.

Photo courtesy of Keith Porter

2. Enhancing the recycling and re-use of phosphorus and nitrogen on the farm through comprehensive farm forage system management

Objective: To improve nutrient cycling within the farm boundary and reduce nutrient loss from the farm through management of the homegrown forage crops. This objective contributes to reducing the Initial Source barrier and the Transport barrier leading to improved mass nutrient balance and reduced phosphorus accumulation on the farm and subsequent risk to runoff.

Program and results: Forage system management is the logical next step to integrate with and enhance Precision Feeding. It also links crop nutrient planning and precision feeding. Improved or highly intensive forage system management leads to improved forage quality, which in turn leads to more forage consumption and less purchased concentrate or mineral supplementation. This work was initiated through DCAP under a Safe Drinking Water Act grant. The work is nearing completion and there are indications that:

1. There is a significant potential for improved phosphorus cycling on the farm with corresponding reductions in imported phosphorus.
2. Under intensive forage management phosphorus content of the forages increases. This allows for decreased mineral P imports in feed as the result of increased crop removal of P from soil.
3. Through the use of different forage systems phosphorus losses to the water can be reduced.
4. These reductions are quantifiable.

5. The unique feature of this is that DCAP is demonstrating and quantifying water quality benefits while enhancing the economic strength of the farming community.

Proposal discussion: Through the implementation of a phased pilot project it will be further demonstrated how the objective of this component can be achieved. It will be accomplished through a greater removal of soil P by crops and producing improved quality of homegrown forage that will allow for greater inclusion of homegrown nutrients in dairy cattle diets on the farm thereby reducing the need for imported nutrients. Additionally, this component will seek to implement forage management techniques that will reduce loss of nutrients from the farm via erosion runoff and leaching. This component primarily serves the long term DCAP goals of relief from the phosphorus restriction and maintaining water quality below those thresholds in the Cannonsville Basin.

This component is related to the third component of the program, manure nutrient management, in that manure nutrients are applied in supply of crop nutrient requirements. However, the comprehensive farm forage systems management addresses many facets of forage management beyond crop nutrient supply, such as forage crop species selection (which impacts soil erosion and hence nutrient loss, soil nutrient removal by crops, as well as animal feeding management), fertility management (which impacts nutrient applications and removals and animal feeding management), and harvest management (which again impacts crop nutrient removals as well as animal feed management) among others. New technologies and management strategies will offer many other opportunities to impact nutrient cycling on the dairy farm.

Recommendation: CCE/DC specialists will work with farmers in a "one on one" basis to assess the forage system on their farms and determine the opportunities to improve nutrient cycling on their farms, help these producers assemble strategic and tactical plans to realize these opportunities, and then assist in the implementation of these plans. As forage produced on the farms becomes part of the feed inventory for the dairy cattle on the farm, it is logical that these farms participating in whole farm forage system planning would also be participating in the precision feeding program, in order to fully realize nutrient cycling benefits.

A forage systems management program will need to begin with a pilot phase (Phase 1) to develop, test and refine the planning and implementation process, as this process is not as well defined and is more complex than the precision feeding program. Modeling and documentation of the affects of various forage management strategies on the nutrient cycles of the farms will be facilitated through further development and use of the cuNMPS software. Cornell modeling specialists involved in the development of the cuNMPS will work side by side with CCE/DC forage planning specialists in developing and implementing forage management plans, assisting in the adoption and refinement of the cuNMPS.

The institutional needs for implementing a basin wide program will be examined. The proposed farm forage systems management program could be implemented in phases in accordance with funding availability. The development and testing of this program will be conducted through CCE/DC, Cornell University and the New York State Agriculture Environmental Management program. Given that nutrient management plans would be

highly integrated with forage systems management, it would be most appropriate to develop a program and administrative process with the Watershed Agricultural Program in

the New York City watershed for the purposes of transitioning the implementation of the program to the farming community.

This program was developed with the idea that it potentially operate as an incentive based program in which farmers, if funding was available, could receive financial assistance to make voluntarily changes in their forage systems. The transition costs to different forage systems will vary from farm to farm and costs will vary widely as well. However, through this project we will better understand what will be required to make the
transitions. The following is a summary of the proposed comprehensive farm forage systems management program.

1. Begin process development and pilot on 10 farms (hopefully in conjunction with the same ten farms demonstrating precision feeding).
2. Employ CCE/DC crop specialists and Cornell University CUNMPS software team in developing and piloting the whole farm forage systems planning and implementation process, including development of software planning tools and their application in the field.
3. Will engage the CCE/DC specialist in integrating precision feeding strategies on these farms and assisting with process development.
4. Develop new initiatives as technologies emerge.
5. This program will eventually be extended to more farms in the basin following development and testing of the planning process.
6. Determine administrative and institutional needs for delivery.
7. Train whole farm planners to use Forage System Management in the Whole Farm Planning Process.

3. Avoiding excess applications of phosphorus and nitrogen to farm fields through manure management

The proposed manure nutrient management component would include the work that is currently being conducted in nutrient management planning under the WAP. This includes the manure nutrient management plans as they relate to crop nutrient needs and farm hydrologic conditions, which addresses nutrient loss via timing of spreading and soil nutrient accumulation in individual fields (manure nutrient distribution). The proposed nutrient component would go beyond manure application management to also include options for manure nutrient export from the farm and watershed.

The current manure nutrient management program implemented by contracting agencies in the WAP, is already established and should continue to provide nutrient management planning for watershed farmers. Manure application plans need continual updating as crop conditions change in order for them to be useful to the farmer. For this reason a viable and responsive team of specialists dedicated to the development and maintenance of manure nutrient planning, using the cuNMPS Cropware software for manure nutrient application planning is critical.

On farms that are participating in the whole farm forage systems management program, it is logical and necessary that there be a very close working relationship between the manure nutrient applications planning and the whole farm forage systems planner. The whole farm planner performing the manure nutrient application planning on farms may in fact be the same person conducting forage systems planning due to the integration needed for both components.

The usage of cuNMPS Cropware software by Cornell Cooperative Extension Planners in the WAP represents perhaps one of the most widespread uses of this software in New York State. As a state of the art tool that incorporates the best science, this is of great benefit to the stakeholders in the NYC watershed. Further refinements and adaptations of this software as a result of its application on farms in the NYC watershed will be not only likely, but useful for its continued usage in the watershed. Support will be provided to Cornell University to work with nutrient planners in applying this software and making future refinements.

Manure Management Component

1. Manure nutrient application planning continues as it has evolved under the direction of CCE/DC Staff and the Natural Resource Conservation Service (NRCS) as part of the WAP.
2. Employ Cornell University for continued development and training on cuNMPS software.
3. CCE/DC forage systems specialist continues to interface with and provide guidance for current program, assisting in the adoption and implementation of the Cornell Cropware software.
4. We propose that the CCE forage systems planner would most likely work with a WAP whole farm planner responsible for manure and nutrient management planning on cooperating pilot farms.
5. This program needs to integrate firmly with the whole farm forage systems management program long term.
6. Develop new initiatives as technologies emerge.

Proposal discussion: Manure redistribution, removal, treatment, and use is a key component to improving water quality in the Cannonsville Reservoir. This initiative was identified in the Ad Hoc Policy discussion regarding agriculture (1991) as critical to decreasing nutrient loading to the water supply. This component would evolve directly from the nutrient management work that is currently being conducted in nutrient management planning under the WAP. This includes the nutrient management plans as they relate to crop nutrient needs and farm hydrologic conditions, which addresses nutrient loss via timing of spreading and soil nutrient accumulation in individual fields (manure nutrient distribution). This component would go beyond manure application management to also include manure nutrient export from the farm and watershed, such as through a composted product derived from either an on farm or centralized compost facility. This effort contributes to improving the success of the transport barrier.

Early work conducted under DCAP and funded through a WEAP grant, indicates that one option to reduce the loading of phosphorus specifically in manure appears to be adopting a manure management system that may include composting. The study shows that manure export via composting has the potential to significantly reduce P loading to the

Cannonsville reservoir. From a water quality perspective the form of manure exported is irrelevant. Opportunities for the export of raw manure will also be explored as well. In fact exports of small amounts of raw manure may hold potential for offsets as well. Manure management is therefore a key nutrient management strategy of the CFNMS. Management of manure nutrient through a compost process, if managed properly, may also provide the benefit of destroying pathogens. This component would serve both the short and long term objectives of DCAP. It bears repeating that participation by farmers in any manure P offset program would be voluntary.

Recommendation: Develop a business plan to determine the actual costs associated with implementing manure management strategy. In the event a business plan is implemented, it is anticipated that the WAP would incorporate this into their "tool box" of options to meet nutrient management thresholds.

A DCAP Business Plan for Manure Management Strategy is being compiled under DCAP, which includes capital and operating costs based on local data. This committee includes participation from a variety of watershed partners. The main components of that study are outlined below and are continuing to develop.

Business plan outline

1. Marketing compost.
2. Determining where the excess manure is.
3. Composting alternatives to evaluate, associated infrastructure and farmer needs.
4. Offset development.
5. Administration of this project and drafting the work-plan for Army Corps.
6. Determine post project long term oversight/administration of offsets and implementation.

4. Scientific development and support for comprehensive farm nutrient management systems

(A reminder here that Dr. Fox's text uses the CUNMPS acronym where we use CFNMS.)

Software Development: Of critical importance is the continued development of the cuNMPS package of software. Professor Danny Fox (Animal Science, Cornell) leads a team in the development of such software. Below is a summary of who is involved and a history behind the development of the software.

Project Leaders: Danny Fox (Department of Animal Science), Karl Czymmek (PRO-DAIRY), Quirine Ketterings (Department of Crop and Soil Sciences), Tom Tylutki, Greg Albrecht and Caroline Rasmussen (Department of Animal Science).

Collaborators:

- CALS Integrated Nutrient Management Program Work Team (CALSINMPWT)
- New York State Water Resources Institute
- Cornell Cooperative Extension of Delaware County
- New York City Watershed Agricultural Program

Background: In 1999, the United States Department of Agriculture (USDA) and Environmental Protection Agency (EPA) released guidelines for developing Comprehensive Nutrient Management Plans (CNMPs) for Animal Feeding Operations (AFO) to protect water quality from non-point sources of pollution. New York State (NYS) has developed the Agricultural Environmental Management (AEM): initiative to protect water quality from agricultural pollution and, thereby, address USDA and EPA guidelines for comprehensive nutrient management. The NYS Soil and Water Conservation Committee is responsible for the development, coordination, and establishment of policy for the AEM initiative. The state AEM Steering Committee is responsible for recommending policy to the aforementioned committee, generating a statewide plan of work, and developing training programs and materials to implement the policy and plan of work. Program work teams at the county-level, comprised of local Cornell Cooperative Extension (CCE), Soil and Water Conservation District (SWCD), Farm Service Agency (FSA), Natural Resource Conservation Service (NRCS), and Department of Environmental Conservation (DEC) personnel, are then responsible for implementing the state policy and plan of work. The primary tools developed by the state AEM Steering Committee for applying AEM policy have been the guidelines and worksheets that define a five-tiered approach to the planning and implementation of CNMPs. As outlined in Tier 3B, the CNMP should provide the strategies and tactics for environmentally and economically sound agricultural production based on the recommendations of the land grant university (Cornell University) and partnering agencies in NYS. Most livestock farms in NYS will be expected to develop a CNMP, so implementing and refining efficient mechanisms for the delivery, application, and evaluation of such recommendations will greatly assist in the development of effective plans and the protection of water resources.

Because of the complexity in accounting for all of the variables involved in developing a workable CNMP and to insure the use of Cornell recommendations based on the best science available, the state AEM committee strongly supported the development of the Cornell University Nutrient Management Planning System (*CU*NMPS) to provide a software system for use as a common standard in developing Comprehensive Nutrient Management Plans on farms in NYS. Three members of the AEM committee, NRCS, Dept. of Agr. and Markets and DEC, provided the financial support for the development of the *CU*NMPS. This software package, comprised of two computer programs, is being distributed at no charge to all CCE, SWCD, and NRCS field staff, as well as any other interested parties in NYS. The combination of both herd and crop nutrient management programs allows the *CU*NMPS to be used for improving on-farm nutrient recycling and profitability. Within the *CU*NMPS, the Cornell Net Carbohydrate and Protein System (CNCPS) software enables the user to develop progressive animal nutrition plans to maximize nitrogen (N) and phosphorus (P) use efficiency across the herd by reducing both nutrient inputs associated with purchased feeds and nutrient excretion from livestock. Also within the *CU*NMPS, the Cornell Cropware program enables the user to allocate manure and fertilizer nutrients based on soil type, crop requirement and environmental risk

indices. The Cornell Cropware program contains equations and coefficients needed to implement Cornell nutrient management guidelines for meeting crop requirements with manure and inorganic fertilizer nutrients. The software also allows for the assessments of P runoff risk, via the NYS P Index, and N leaching loss, via the NYS Nitrogen Leaching Index. Recommendations and nutrient management plans generated using Cropware are designed to comply with NRCS standards.

The next step needed to successfully implement the *cu*NMPS in the New York City Watershed Agriculture program is to provide the training and support for implementation of this software to reduce non-point source pollution from agricultural activities on NYS livestock and field crop farms. Such a step includes the following:

1. Implement the Cornell Nutrient Management Planning System on as many farms as possible in the New York City Watershed and provide training and support for users of the software. Implementing both the herd nutrition and crop and manure nutrient management software will reduce nutrients entering the farm gate via feed and fertilizer (source control) and improve field allocation of manure through the application of agronomic recommendations, the P Index, and the N Leaching Index.
2. Utilize Case Study Farms to determine how to integrate the herd nutrition and crop components for use in developing whole farm nutrient management plans that reduce imported nutrients through an integration of precision feeding and crop/forage management programs.
3. Develop new and improved releases of the software based on user feedback and continuing research. Included will be record keeping and crop rotation optimization components, and to foster an increased use of the *CU*NMPS for Comprehensive Nutrient Management Planning in the New York City Watershed.

This project is supported at the University and in the field by the extension efforts of the following Cornell Programs: CALS Integrated Nutrient Management Program Work Team, CSS Nutrient Management Spear Program, Dairy Management Program, and the PRO-DAIRY Program. Animal nutritionists, consultants, agronomists, natural resource conservationists and AEM Planners across NYS, from both public and private sectors, will be provided with the results of this work and enhancements made to the cuNMPS, thus providing an outstanding grass-roots implementation effort necessary for continuing effective nutrient management in NYS.

Ongoing Science: On-farm Phosphorus and Management Studies

The phosphorus balance and associated management issues on the farm will be scientifically evaluated on pilot farms. The uniquely extensive water quality database available from the upland monitoring farm provides a basis for further research into tracking phosphorus generation and movement on that farm should they choose to continue. With agreement by and permission from the upland farm owners, field-scale monitoring along with detailed modeling would greatly increase the value of the water quality data already obtained. A major objective would be to construct a phosphorus mass balance that accounts for loads as measured by DEC at the tributary outlet of the farm. The

methodology developed through such scientific assessment would then be applied to other farms to aid in identifying critical source areas and specific management options.

These farm assessments would assist in identifying management measures to reduce phosphorus losses from the farm. The feasibility and potential advantages of precision farming techniques for improved feeding strategies, crop production, and application of manure and commercial fertilizers, would also be evaluated for farms in the basin. Management measures identified and agreed upon with the cooperating farmers could then be implemented on their farms. The assessments should also consider potential benefits in
reducing pathogen and other risks. It is likely that management measures designed to control losses of phosphorus will also have significant additional benefits of controlling pathogens and nitrogen. Under certain conditions nitrogen can, for a short period of time, become the limiting nutrient for algae growth in Cannonsville Reservoir. It would therefore be helpful to perform an assessment of the reduction in risk posed by these potential contaminants.

Monitoring and evaluation

The proposed farm scale work will continue, which began in fall 1999 under an approved WRDA-WEAP grant to Delaware County. The later work will seek to change the forage resources on the pilot farms. Like the WEAP Project, however, supplementation strategies will be identified and altered (if necessary) to reduce phosphorus imports and excretion. Changing forage resources on the pilot farms explores more fully the extent to which feed phosphorus imports might be reduced on typical dairy farms. In 2002 it is anticipated that monitoring on a lowland farm will begin to examine the dynamics of another farm type.

D. Septic systems and septage disposal

Scientific needs were recently answered regarding septic system assessment include in a study entitled, Phosphorus Impacts From Onsite Septic Systems to Surface Waters in the Cannonsville Reservoir Basin, NY.

This study was undertaken to determine the potential phosphorus contributions from onsite wastewater treatment systems (OWTSs), commonly known as septic systems within the watershed of the Cannonsville Reservoir.

The glacial till soils of Delaware County, typically located in the uplands of the county have characteristics that interfere with treatment functions of conventional OWTSs. Restrictive subsoil conditions in the basin strongly favor perched water tables and thin zones of "interflow" across much of the landscape.

Based on DEP records and NRCS soil mapping, GIS analysis strongly indicate that the majority of OWTSs use effluent distribution devices of designs inappropriate for the soils in which they were installed. The problems caused by the inappropriate fit between soil characteristics and OWTS leach field design increase the likelihood of inadequate treatment of septic system effluent. This may have public health implications beyond environmental phosphorus discharges, such as pathogens transport.

Existing research has demonstrated that phosphorus is relatively immobile in soils when compared to most solutes. However, soils have a relatively fixed capacity to sorb P and,

once this capacity is saturated, further P additions will advance at a rate to be determined by the interaction of effluent, soil and groundwater flow parameters.

It is estimated that existing residential OWTSs in the basin, number about 6773. Assuming a typical effluent P concentration of 5.3 mg / L, the 6773 OWTSs would produce a total of 6257 kg of P per year in their effluent. An average distance of 417 feet separates the OWTSs and surface waters. The average age of OWTSs in the basin is about 30 years (Day 2001).

Considering the estimated average OWTS age of 30 years and the generally poor fit between existing soils and OWTS designs, it would appear advantageous to have some form of regular inspection, maintenance, and rehabilitation of OWTSs in the basin. Inspection would help illuminate the magnitude of the OWTS problems, and appropriate maintenance should follow, ideally. Rehabilitation or replacement will probably be appropriate for a large portion of OWTSs, based upon the information presented here. It is recognized, however, that a dedicated program to effect regular inspection and maintenance seems unlikely to occur without some form of financial assistance to the homeowner, along with some form of assurance that inspection would not open them up to potentially large financial obligations.

Recommendation: Assure adequate funding at CWC for the replacement repair, and maintenance of OWTSs. Assist communities in the establishment of septic districts to insure reliable and adequate maintenance of individual septic systems.

E. Stream corridor protection and rehabilitation

The West Branch of the Delaware River basin above the Cannonsville Reservoir covers an area of 353.5 square miles with a total of 662.4 stream miles. Due to an array of contributing factors, there are numerous areas of unstable stream reaches that contribute to the sediment supply and associated nutrient loading within the system. Aquatic habitat is also significantly impacted.

Delaware County recognizes that major work is already planned for the management of stream corridors in the Cannonsville Reservoir Basin. Without duplicating this work, opportunities for coordination between the DCAP and this existing work, in particular with the DEP's Stream Management Program is currently being organized.

Delaware County Soil and Water Conservation District is developing a practical Stream Corridor Management Plan (SCMP) with crucial input from residents, local and state agencies, and other interested organizations to aid in managing the West Branch of the Delaware River basin in order to achieve the objectives as defined by these groups.

The SCMP will utilize a fluvial geomorphic approach for use by local agencies and residents when addressing water quality improvements, aquatic habitat enhancement, flood hazard mitigation, stream channel stabilization, and other pertinent objectives.

A GIS database and library system has been set up and organized for use in managing current data obtained from DEP and future data as it is compiled. Aerial photographs have been scanned into the GIS system and georeferenced with the current digital ortho quarter quad

photographs (DOQQ's) for the main stem of the West Branch and Town Brook in Stamford. Stream edges have been identified and maps have been produced with this data for use in identifying priority areas and stable reference reaches and as an aid for stream classification. Rosgen Geomorphic Characterization for these watercourses have been completed. This process is part of the stream classification protocol
that categorizes streams into specific types with similar characteristics. This information is extremely useful in developing future restoration plans and management scenarios. Riparian owners along the West Branch main stem have been identified and data based to facilitate program/landowner contact. A Project Advisory Committee has been established
consisting of local agency representatives and residents to consult with the Project Team, assist in the SCMP development, to help solicit input from riparian landowners. Additionally, a public outreach effort is under development. A USGS stream gauging station has been calibrated and the information will be added to the current database for use in watershed assessments.

Recommendation: Acquire funding to implement three streambank protection demonstration projects.

Note: *DCAP assesses and determines the management needs of these components comprehensively within their basin-wide context*

V. DCAP Institutional and Operational Procedures:

A. DCAP establishes and is based upon a credible and sound scientific foundation

It is a basic tenet that the Delaware County Action Plan must be formulated on a credible, scientific foundation. Two principal issues are: The achievement of specific contaminant reductions by individual management options adopted under DCAP, and meeting overall basin level goals of contaminant load reductions. The DCAP proposes to reduce risks by applying the precautionary principle. This principle requires managing risks so that uncertainty and variability are taken into account in developing and evaluating management practices. The County Scientific Support Group (CSSG) was convened and remains actively involved in providing the necessary technical expertise for this effort. The functions of the CSSG are described in section V: D. Beyond applicable regulatory requirements, DCAP is voluntary and dependent upon the availability of funding.

All projects are collaborative and depend upon one or more of the following elements of scientific support: knowledge of basin and site-specific hydrology and loading mechanisms, use of mathematical models, and results from field, stream and reservoir monitoring. There is already a very solid foundation of phosphorus loading information gathered over many years by the DEC and an extensive water quality and quantity database for the Cannonsville Reservoir basin developed by several entities including DEP, Upstate Freshwater Institute, United States Geological Survey (USGS) and DEC. These data enable characterization of past and existing loads of phosphorus and other contaminants from the watershed and corresponding reservoir trophic conditions. In addition,

considerable modeling of the reservoir's contributing watershed with the Generalized Watershed Loading Function (GWLF) model, and the reservoir itself with the Cannonsville Nutrient-Phytoplankton model developed by Upstate Freshwater Institute (UFI), has been accomplished. These, and other, models have provided a basis for assessing future expected

loads under different scenarios achieved by BMPs proposed within each implementation project of the DCAP and their potential effects on reservoir water quality.

DCAP adopts the following scientific assumptions:

- The purposes and performance of the Delaware County Action Plan require solid/scientific support.

- Quality of the NYC Water Supply depends upon identifying and reducing risks. Risk reduction will assume the precautionary principle.

- To the extent feasible, scientific support should be provided by an inter-agency group of scientists and associates with the expertise in the Cannonsville Basin, as well as those generally concerned with the New York City Watershed. This group aims to seek and maintain a scientific consensus for the DCAP as it is developed and implemented.

- The projects, and the scientific rationale underlying their selection and their technical designs, should be properly documented to advance or meet policy, regulatory or public informational needs at local, NYC, state or federal levels.

- Technical design criteria for implementation projects should be derived from calculations of risks, to provide quantitative estimates of the contaminant load reductions the projects will achieve. A key scientific step is to estimate the frequency or range of possible loadings over time associated with management practices. By defining an upper bound of the estimated range as a design level for the practice, inherent variability can be quantifiably taken into account. The design level then becomes a conservative estimate of the load associated with that practice. In calculating overall load reductions sought, the error will be on the side of underestimating the actual reductions achieved.

- As economically feasible, implementation projects should incorporate redundancy, such as multiple barrier considerations, to ensure water quality aims are met under all the design conditions for each project. This precautionary objective allows for uncertainty.

- Specific phosphorus load reductions, and other contaminant controls, achieved by implementation projects should be accounted for in terms of how they quantitatively contribute to phosphorus reductions, and to the overall phosphorus balance in the Cannonsville Basin, to the extent possible. While there is no language in the MOA or regulations to administer and implement a phosphorus credit program or a bank of documented projects

  that could be used as offets, Delaware County seeks aid from DEP, the state and acceptance from EPA to develop one.

- Financial guidance and economic assessments have been and continue to be undertaken for each selected project to determine the best means of meeting the costs of implementing the projects and to yield information by which the

economic costs to businesses and communities in meeting the phosphorus restrictions can be estimated.

B. Planning, management and evaluation depend upon sound quantification using extensive monitoring and modeling.

Proposed monitoring and evaluation to support DCAP

The DCAP proposes to comprehensively manage point and non-point sources of phosphorus to relieve the phosphorus restriction imposed in the Cannonsville Reservoir basin. There are very high economic stakes for the businesses, farmers, communities, and residents within the reservoir basin. It is critical, therefore, to continue with a scientifically sound management program for the basin.

In order to record accomplishments of the DCAP in reducing phosphorus loading to the Cannonsville Reservoir, establishing surrogate measures for water quality monitoring must be established and applied. There continues to be a need to identify, select, implement and record management measures to reduce phosphorus loading. Such decision making cannot be deferred while waiting for validation from long-term water quality monitoring. Ultimate validation of the success of the DCAP in reducing phosphorus, however, will be provided by water quality monitoring. It is important therefore, that the DCAP be coordinated with DEC and DEP water quality monitoring programs. This coordination function could be achieved through the CSSG.

Existing scientific foundation

A comprehensive, event-based monitoring program has been carried out on the West Branch of the Delaware at Beerston under the leadership of the DEC. The DEC is also carrying out a paired sub-basin study. This study is a sound basis for evaluating the effectiveness of management practices adopted by the WAP. There have also been high quality studies of Cannonsville Reservoir itself and a mechanistic model developed by Upstate Freshwater Institute that links load inputs to reservoir water quality. This provides the means to relate, through monitoring and modeling, the response of the reservoir to external loadings. With additional monitoring and modeling for the purpose of developing a more complete accounting of phosphorus, its sources and their distribution in the basin and in time, comprehensive management of phosphorus in the basin could be better accomplished. Hence, both residents of the basin and consumers of New York City water would be well served.

Purpose

The purpose of the work proposed is to evaluate and guide the development and implementation of the phosphorus reduction program in the Cannonsville Reservoir basin. It is critical to achieve phosphorus reductions from all significant sources of the nutrient. It is equally necessary to develop a reliable methodology for measuring and confirming those reductions in meeting the requirements of the phosphorus restriction. Such measurement and confirmation will assist in the implementation of the management program and in verifying scientifically to those concerned that it meets its objectives.

In 1995, an inter-agency Research Action Group, jointly established under the auspices of the WAP and the DEP, assessed and identified scientific needs and objectives.Particular needs included a monitoring and modeling agenda for the Cannonsville Reservoir basin. It was suggested through the group that the proposed scientific assessment of the Cannonsville basin explicitly consider a balance between four geographical scales: the field scale; the farm and community scale; the sub-basin scale; and the entire basin scale. DCAP has implemented these suggestions developed by the Research Action Group. The work at each scale will be carefully integrated to ensure a balanced use of funding and staff resources to provide the best management information achievable.

- **Field Scale.** Specific monitoring and modeling needs identified at the field scale are to ascertain levels of dissolved and particulate phosphorus under different conditions and the mechanisms controlling those levels. Of particular importance is the need to further investigate loss of dissolved phosphorus in subsurface flows. As suggested by certain research studies, this could be a hitherto significantly underestimated source of phosphorus from manured fields and possibly subsurface wastewater disposal systems. Another need is to track phosphorus movement on farms by modeling generation and transport at the field scale. This will assist in application of criteria for identifying high risk areas and in development of appropriate BMPs. The current upland monitoring farm provides a suitable site for initiating this work as DEC, through its present monitoring efforts, has in-stream load information that can be linked back to field scale studies. Also, extensive work has already been done on this farm at the field scale which can be built upon.

- **Whole Farm Scale.** Intensive monitoring of an upland farm is already being conducted by the DEC under contract with WAC. The value of the information being obtained shows the desirability of both continuing this type of monitoring and extending it to include at least one complementary lowland farm. Lowland farm monitoring is scheduled to begin in 2002.

- **Community Scale**. It is desirable to monitor at the community scale to better quantify contributions from and urbanized area. Stormwater monitoring has been conducted but in a recent peer review of the SWAT model at Cornell it was recommended that more be done to make the database supporting SWAT more robust.

- **Sub-Basin Scale.** It is highly desirable to give high priority to installing additional stations in this basin. This will assist in completing the monitoring to provide scientifically sound and more detailed knowledge of the distribution of the principal

phosphorus sources, their impact spatially and in time, and the effectiveness of management measures to reduce the levels of phosphorus released by the sources. Town Brook is already being monitored at its outlet by DEC and at its headwaters by USGS.

☞ **Entire Basin Scale.** There is already a major monitoring station at Beerston just upstream of the reservoir on the West Branch. It is recommended that this site be continued for the long-term. Automated sampling has begun. Beerston, however, only accounts for 80% of the entire Cannonsville Reservoir basin. Trout Creek drains most of the remaining 20%. Monitoring by DEC of the Trout Creek Basin is expected to begin in 2002.

☞ **Wastewater Treatment Plants.** In the 1999 version of DCAP it was recommended that increased sampling of WWTPs in the Cannonsville Reservoir basin be undertaken to provide more accurate estimates of current and future phosphorus loads from these point sources. More frequent sampling would help account for diurnal, weekly and seasonal variations in effluent phosphorus concentrations and lead to better estimation of loads.

From that recommendation, DEC increased sampling frequency at the Walton WWTP in October 1999 from quarterly to monthly and initiated sampling at the Delhi WWTP in September 2001. DEC now collects seven consecutive 24-hour composite samples every month at both Walton and Delhi and analyzes them for total and dissolved phosphorus. DEC also utilizes discharge and phosphorus data provided by the WWTP operators through their self-monitoring program to calculate loads. Results indicate that effluent phosphorus loads at Walton have been decreasing over time as improvements to the plant have been made. This upgrade was not online as of this writing.

In Walton the local dairy processing plant, which pipes its wastewater to the WWTP for treatment, has recently invested significantly in pre-treatment technology. Reverse osmosis equipment for whey waste has been installed and capital investments for the implementation of a spill prevention program have been made. The Walton WWTP manager believes these changes have contributed to improved performance of the WWTP. Flow from the plant is more consistent and the Biological Oxygen Demand (BOD) load is less problematic (2002).

We recommend that this sampling regime continue through the implementation of the WWTP upgrades and for a time thereafter to monitor the impact of the upgrades. This will assist in better defining both point and non-point sources phosphorus loads to Cannonsville Reservoir over time.

Integration and analysis through models

Under projects within the Delaware County Action Plan, Delaware County has adapted a watershed model for hydrology and phosphorus, and has integrated with GIS databases. At this time the set would cover at least the whole basin and sub-basin scales by the time that this proposed work begins.

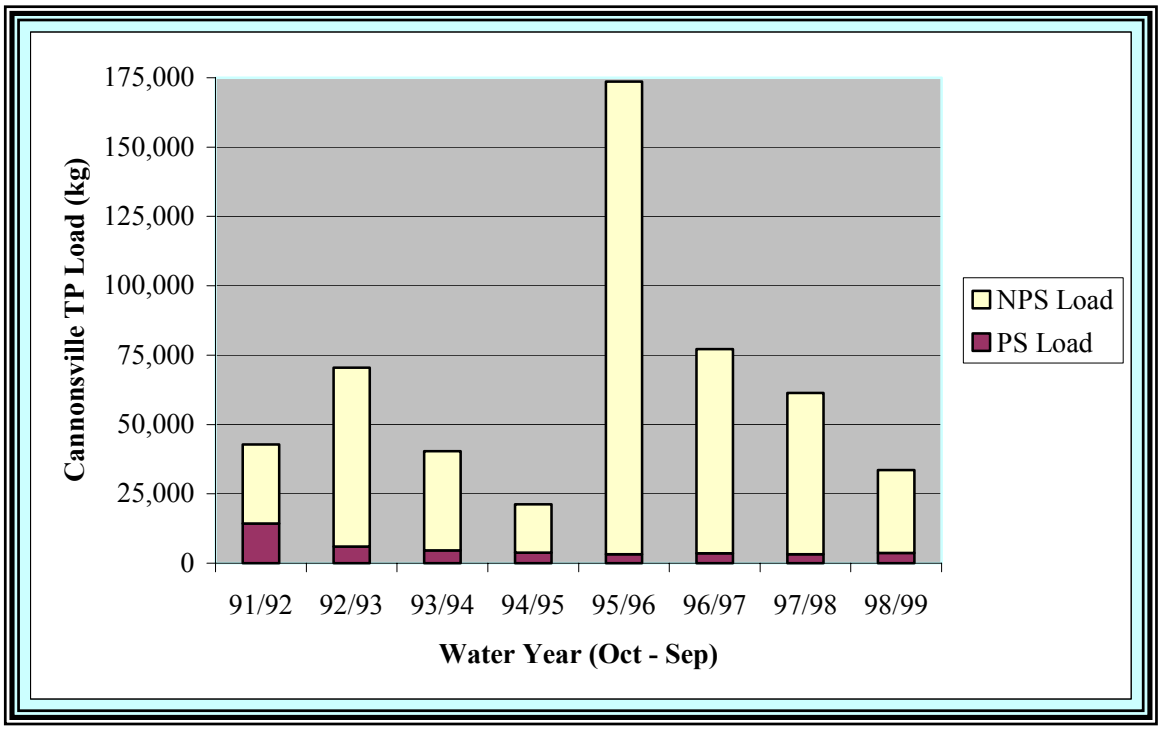
- The model set would be applied and enhanced during this proposed project. Applications would include (1) the design of special studies and (2) the interpretation of the earliest data yielded from the sub-basin and community scale

monitoring to relate observed stream quality to activities on land within the influencing catchments. As in the 1999 model applications, the models also serve as synthesizers of various field data for use in priority-setting and basin- and community-scale phosphorus management projects.

- One model enhancement expected during this period would include increased spatial resolution within the catchment areas whose outflow is monitored at the community scale (smaller than sub-basin). Continued monitoring at Beerston (full basin scale) would increase the database patterns in phosphorus delivery to the reservoir.

- Although point source reductions will reduce phosphorus loading monitoring data clearly suggests that point source controls will not adequately reduce the phosphorus load to the Cannonsville enough to minimize the impact of the variability of non-point source loading. Although the watershed regulations will help reduce the level of phosphorus in the Cannonsville by requiring more stringent phosphorus limits at existing wastewater treatment plants, phosphorus loading from point sources currently represents small portion (less than 10% of future predicted load) of the annual load of total phosphorus (Fig. 1). Data published by the DEC relating to phosphorus loading from point and non-point sources in the Cannonsville Basin indicate that "phosphorus loading from point sources has been steadily reduced over the last decade (the reduction was due mainly to a major upgrade of the largest facility, i.e., the Village of Walton). As noted earlier significant improvements at the local dairy plant are contributing to those reductions as well. Non-point source loads, in comparison, are large (approximately 90% of predicted load) and exhibit a considerable variability from year to year as evidenced by the low and high load years of 1994/95 and 1995/96, respectively," as illustrated in Figure 1, (Longabucco 2001).

Figure 1. Point source (PS) and Non-Point Source (NPS) Loads in the Cannonsville Reservoir



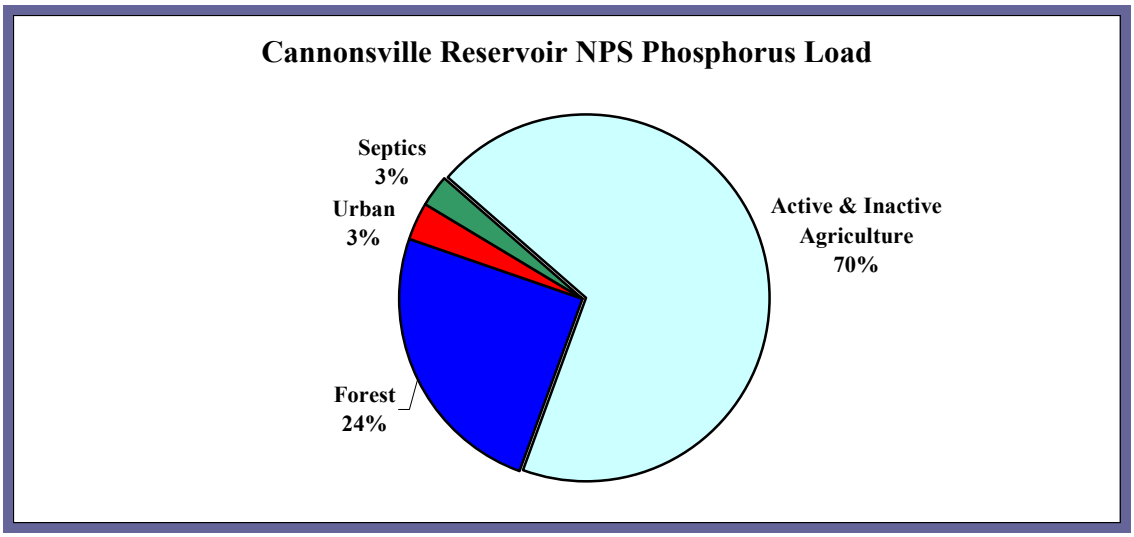
(Longabucco 2001)

Other than the upgrade of existing wastewater treatment plants (WWTPs), the other phosphorus-specific control measures required by the watershed regulations are a prohibition of new surface water discharges from sewage treatment plants and a requirement that new or modified facilities prepare stormwater pollution prevention plans for phosphorus removal. While these measures will help prevent the water quality from further degradation, they will result in little actual water quality improvement.

A rational control program for non-point source should rank manageable sources in order of potential contribution and target those for management that pose the greatest threat. Threat can be determined by the relative abundance of the source, its proximity to, or ability to, enter watercourses, and other factors. An examination of the relative breakdown of P contribution by the source to Cannonsville Reservoir in "typical" year suggest likely areas that should be targeted by the Delaware County management effort as illustrated in figure 2.

While smaller sources, such as urban areas and point sources must not be ignored, it is imperative the Delaware County management effort effectively target the most significant source in the watershed to ensure reductions sufficient enough to prevent phosphorus restrictions in the future.

Figure 2. "NPS load by land use," Data for chart provided by Porter, 2001.



Pie chart provided by Patricia Bishop, (DEC) 2001

Continued monitoring and assessment efforts are integral for a number of different purposes including:

1. Providing input for testing, calibrating and validating models.

2. Evaluating the specific goals for the county in terms of phosphorus reductions.

3. Aiding in the development of a cost-effective, targeted strategy to reduce phosphorus loads from major sources.

4. Estimating the amount of contaminants conveyed immediately from the managed site, in runoff or subsurface flows to streams, and hence to the reservoir before and after the completion of the projects.

5. Tracking changes in water quality after BMP implementation, including quantifying phosphorus reductions achieved.

Application of watershed models to select initial implementation project sites

A primary function of modeling continues to be hydrological and phosphorus assessment at the site-specific, sub-basin and basin scales. There are several candidate models that are well regarded and widely used. Several models have been developed for the Cannonsville basin through the efforts of scientists at Cornell, the DEP and the DEC. These models are helpful but do not satisfy the more detailed evaluations required for the management program proposed by DCAP. Delaware County is using the Soil and Water Assessment Tool model as the model of choice for basin and sub-basin decision making and "what if" scenarios in the Cannonsville basin and has been modified to meet the specific needs of this basin. This effort has been complemented by the evolution of GIS technology at the county level and training of county staff in its applications. Staff continue

to work towards completing GPS and GIS work to inventory stormwater systems and highways in the basin. A complete hydrological and mathematical analysis of the entire basin, combined with the requisite GIS, has required cooperation, sharing and further development of GIS and modeling resources of Delaware County, DEP, DEC, WAP, and other cooperating parties. In the work supported by the WEAP and SDWA funds, obviously important sites have been selected for implementation prior to the completion of a detailed basin-wide hydrological and phosphorus assessment. Concurrently, an assessment for targeted phosphorus management and evaluation of its results is being completed. To initiate the DCAP a 'broad brush' evaluation of the whole basin was made. For the purpose of initial selection and evaluation of project sites, detailed analyses were applied at two levels: to phosphorus source categories and to sub-basins. In particular, mathematical modeling was applied to undertake frequency analyses as a basis for specifying design criteria to be met by BMPs in each project and in accounting for the reductions in loads the BMPs accomplish.

Modeling

Modeling link*s* with data derived from monitoring and other assessment means for the purposes of:

- Estimating the relative contribution of particulate and dissolved phosphorus forms from watershed sources at basin, sub-basin and local geographic scales, as well as from within the reservoir itself.

- Estimating the phosphorus load reduction to Cannonsville Reservoir necessary for maintaining the average in-reservoir total phosphorus concentration at or below the 20 ug/L guidance value, in the most scientifically defensible fashion possible, using the most up-to-date and accurate data and methods available.

- Identifying local critical hydrological areas in the reservoir basin, such as areas prone to flooding or which represent sources with higher risks of contaminant loss.

- Ascertaining where there are needs and opportunities to reduce peak flood/storm water flows and associated peak contaminant transport to the reservoir, and helping to determine priorities and specific sites for storm water management.

- Assisting in assessment and selection of specific sites for risk-based management projects.

- Assessing and selecting BMPs for projects where possible. Additional research may be necessary for confirming the abilities of lesser understood or new BMPs to reduce phosphorus.

- Establishing an independent basin-wide ability through a GIS platform to estimate phosphorus loads, or other contaminant loads, and to reliably determine the cumulative reductions accomplished by all the projects so these can be recorded in the projected phosphorus balance as previously described.

C. It is conducted cooperatively with partners to the MOA, complements and enhances other watershed programs and is transferable to other watershed basins.

In the past five years, the watershed communities have learned much about how to work together on water quality issues and programs. It has also become apparent that some of the local municipal governments have the will, but they do not have the staff or budget to take full advantage of the potential funding sources for water quality protection. Catskill Watershed Corporation's role, as determined by the MOA, is to administer the MOA programs. The CWC has not been commissioned to perform long term comprehensive planning for the communities. Under the MOA, the New York State Department of State (DOS) provided planning funds for local municipalities. Those funds have been successful in helping small municipalities conduct planning for discreet projects. In order to fast track these programs and to perform comprehensive planning similar to the DCAP, we need to have the county governments take an active role in assisting the local communities in planning and coordination. The counties will provide the infrastructure for the local municipalities to perform planning; the projects will be selected and implemented at a local level; and economies of scale in planning and technical support will be provided by CWC and the counties. All of this work would be done in cooperation with the state, city and federal governments. It is also anticipated that here will be a sharing of services and expertise between counties possibly coordinated by CWC so that a successful program can be duplicated from community to community.

Although other basins in the Catskill/Delaware system are not currently phosphorus-restricted, the work and experience in Delaware County is relevant and applicable elsewhere in the NYC Watershed, potentially the state and elsewhere with similar NPS management concerns. The agricultural components of DCAP have been developed in partnership with the state AEM process and have the support of the New York State Department of Agriculture as they serve interests outside of the New York City Watershed. We seek to gain similar support from other watershed partners on other DCAP components. Therefore, it would be mutually advantageous to proceed with the DCAP cooperatively with the CWC and the WAC as a source of funds under the MOA. Sharing to avoid duplicative efforts is clearly desirable with both the WAC and CWC. Similarly, there are opportunities for Delaware County to explore taking proactive steps with respect to that part of the county within the Susquehanna River Watershed and the lower Delaware Watershed to extend the DCAP to that part of the county. By such steps the whole of Delaware County will benefit from the strategy developed through DCAP.

For its own reasons, Delaware County established the Delaware County Office of Watershed Affairs. Under the coordination of that office, Delaware County developed DCAP to reduce phosphorus and other contaminants in the Cannonsville Basin. As part of that planning process, Delaware County developed some water quality protection programs that have potential benefits across the entire watershed. At the urging of its other watershed partners, the Coalition of Watershed Towns (CWT) has introduced the DCAP concepts and programs to the other counties within the watershed. The key benefit of DCAP is that the county uses its planning and technical resources to provide the local towns and communities with the ability to plan for the future with regard to water quality. In order to take advantage of the success of DCAP and to provide comprehensive stormwater planning for its watershed communities, these other counties could rely on existing departments. For example, in Ulster County, the primary service provider would

likely be the Ulster County Health Department. In Greene County, the main service providers could be the Greene County Soil and Water and the Greene County Planning department. Schoharie County is more likely to contract out through its planning department (potentially with other county agencies) for additional services. In particular, these other counties have indicated they want to duplicate the following:

- Comprehensive stormwater planning being performed for the hamlets and villages
- Stormwater planning along state and town roads
- Education and outreach to local towns and villages; and
- Stream restoration work being done by Greene County Soil and Water

County staff could perform the following functions:

- Educate the town/village boards on the need to address stormwater, septic and other water quality issues
- Educate the towns/villages and assist the towns and villages in obtaining funding for projects
- Assist the towns and villages in planning associated with septic and sewers
- Assist towns and villages with comprehensive planning associated with the special challenges of the watershed regulations
- Educate county officials and agencies on watershed related issue
- Educate the public relating to the watershed regulation and water quality management as suggested by the Coalition of Watershed Towns to extend, enhance and complement the educational efforts of the CWC

DCAP – NPS management, Total Maximum Daily Loads (TMDLs) and source water protection

DCAP is a comprehensive watershed management program to reduce phosphorus and other potential contaminants. It addresses NPS in agriculture and rural communities, small businesses with limited resources. It quantifies potential reductions through frugal programs and practices that reduce phosphorus loading. It has demonstrated and developed an institutional framework of multi-agency partners to foster local capacities to assist communities and agriculture.

- DCAP is a model applicable elsewhere to address non-point source load allocations in watersheds that have TMDLs, in watersheds otherwise stressed, or with other objectives to improve or protect water quality.

- DCAP has adopted an operating goal to reduce phosphorus loading from three areas: stormwater, septic and agriculture. In the area of agriculture we quantify reductions in phosphorus imports to a basin based mainly on reductions in phosphorus excretion in dairy cattle manure, the largest source of phosphorus applied to the landscape. DCAP demonstrates how to address NPS reductions in a comprehensive way.

- We have demonstrated that quantification of phosphorus reductions from NPS is possible. It can be done at relatively low cost. Very importantly the methods may result in economic benefits to those who implement practices.

D. DCAP is locally led and has developed county-based technical capacities.

1. Organization and administration

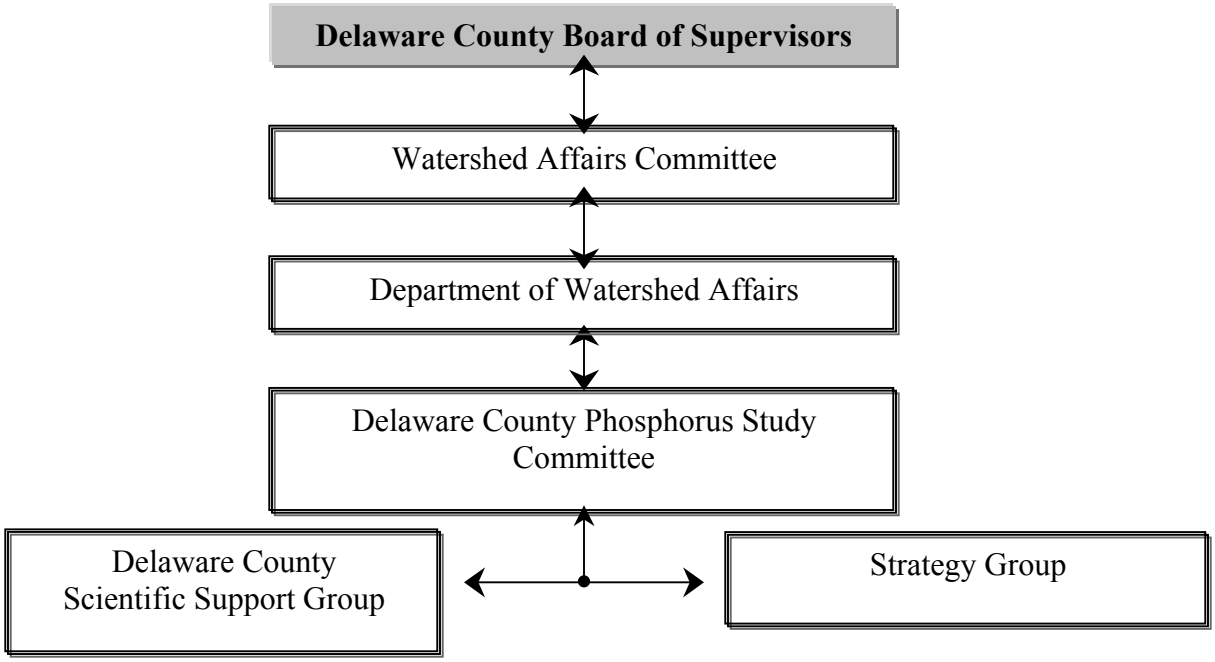
Residents of Delaware County need technical assistance in addressing the DEP regulations. Small businesses and communities can easily become overwhelmed when dealing with the city regulations. To that end the county has, as part of DCAP, formed the Department of Watershed Affairs, added three full-time staff positions to the Delaware County Department of Planning and organized committees for the purpose of aiding residents in complying with the new regulations and meeting the goals of DCAP.

Delaware County in cooperation with the DEP and other watershed partners hopes to make compliance with the regulations more user friendly, expeditious and efficient.
DEP has developed guidance materials on key sections of the Watershed Rules and Regulations and is committed to making it easier for the regulated community to understand them.

As shown in Figure 3. DCAP is under the auspices of the County Board of Supervisors, in cooperation with watershed partners. For its ultimate success, DCAP depends upon local decision-makers, landowners, especially farmers, businesspersons and other stakeholders. Full and voluntary participation of these stakeholders continues to be fostered through DCAP. Core support for county residents is provided through County Departments and County Agencies.

Figure 3. Illustrates the organizational framework for the operation and management of DCAP.

DCAP Organization



2. Committees and their functions

☞ *Delaware County Watershed Affairs Committee*

This committee consists of Supervisors appointed by the full Board of Supervisors. Its purposes include establishing and reviewing county watershed policies. In practice, the above network of committees and agencies they represent is highly effective in fostering and maintaining communication and cooperation for shared watershed purposes.

☞ *Office of Watershed Affairs*

The purposes of the Office of Watershed Affairs include coordination of the overall DCAP program, management of DCAP contracts, development of public information, and liaison to local, regional, state, federal and New York City agencies. The Office of Watershed Affairs reports to the Delaware County Watershed Affairs Committee.

☞ *County Phosphorus Study Committee (CPSC)*

The purpose of the CPSC is to provide a higher level inter-agency forum to discuss and advise the Delaware County Board of Supervisors regarding the activities and planning conducted under DCAP and to relate these activities to other aspects of the NYC Watershed Program. Its membership includes primarily state and watershed partners.

☞ *County Scientific Support Group (CSSG)*

The purpose(s) of the CSSG are to: 1) provide a sound scientific basis for assessing needs and options in the Cannonsville Reservoir basin; 2) substantiate the adoption of

preferred management measures; and 3) subsequently evaluate the effectiveness of the management options implemented review the scientific bases of DCAP. Its membership includes local, state, and federal agencies, watershed and academic partners.

☞ *Strategy Committee*

The purpose of the strategy committee is to provide the agencies or groups working on different components of DCAP to meet and exchange frank views about progress, problems and potential new initiatives or activities.

The CSSG and CPSC are scheduled to meet every month and the Strategy Committee is scheduled to meet every two weeks.

A large number of agencies groups and individuals have participated in the creation of DCAP and will continue to be engaged in its performance. Watershed partners serve on one or more of the DCAP committees and include: the Departments of Watershed Affairs, Public Works, Planning, Economic Development, the Delaware County Soil & Water Conservation District together with representatives from Cornell Cooperative Extension of Delaware County, the Industrial Development Agency, Chamber of Commerce, New York State Water Resources Institute (WRI), New York City Department of Environmental Protection (DEP), New York State Departments of: Environmental Conservation (DEC), Health (DOH), State (DOS), Agriculture and Markets (A&M), the Watershed Agricultural Council (WAC), the Catskill Watershed Corporation (CWC), Delaware County Farm Bureau and other organizations and experts.

3. Capacity building

An important output of DCAP is the building of technical capacity and scientific understanding of DCAP initiatives. This has strengthened the ability of the county to support the local constituency in managing decisions related to non-point source issues. CCE/DC, the SWCD, the DPW and Planning department have each demonstrated their capability to advance the technical and scientific understanding of issues related to reducing pollutant loading and at the same time take into consideration the needs of entire groups and communities in making decisions to reduce pollutant loading risk.

A prominent example is the work of CCE/DC in the arena of precision feeding and forage systems management. This work has demonstrated outstanding potential to reduce phosphorus importation into the basin and better mass nutrient balance on farms while providing potential improvement of finances on the farm.

A second and very critical example is the work of the Planning Department to strengthen the decision making capacity of local communities. Through the application of Geographic Positioning Systems for data collection and the subsequent incorporation into a Geographic Information System (GIS) platform they can now go to the communities and illustrate the power of using sophisticated technology in developing a comprehensive stormwater plan for the communities in the context of a comprehensive community plan. This will assist them in setting priorities for projects.

The purpose of Delaware County's GIS is to provide decision-making support for overall phosphorus reduction and management. GIS is used as a repository for baseline

land use information and data for specific projects under such broad categories as septic systems, stormwater management, highway projects and stream corridor restoration. GIS data being collected will be used for modeling phosphorus runoff given land use conditions and environmental characteristics. The county is currently using RUNQUAL and is currently investigating other models to assist with watershed management in the basin.

At this time there are three (3) full-time staff in the Planning department dedicated to GIS: a GIS Coordinator, a GIS Analyst and a GIS Technician. In addition, the Planners, who will be coordinating the Comprehensive Plans for the communities within the Cannonsville basin, are responsible for the production of their GIS products for each community. While the GIS Coordinator focuses on data standards and maintenance, the GIS Analyst is responsible for ensuring that the modeling programs received will run properly and smoothly. The GIS Technician's role in DCAP is to support related tasks such as assisting with correction of field data and creating maps for papers and discussion.

Delaware County is interested in exploring opportunities to work with the DEC GIS Program: NYC Watershed Data Management and Software Tool Development to capitalize on the resources the state is developing in the watershed and across the state.

A large format plotter and computer software is utilized to support public outreach and display pertinent data to land use professionals and elected officials. The GIS data server is located in Delaware County's Information Technology department, in a dust free, climate-controlled and secure room and is regularly backed up. County GIS Personnel access the server via high-speed fiber optic connection. A small format printer laser-jet printer, capable of printing tabloid size is utilized for supporting smaller maps. The Real Property Tax Service Agency is currently in the process of purchasing a large format scanner/plotter that will be accessible through the GIS network. The county also has an operational GPS Base Station from which correction files are posted to a website that will soon be publicly accessible. For now when correction files are needed, they can be downloaded from SUNY Delhi via a non-public website. The GIS staff, as well as the environmental staff, will continue to receive training in the models the county receives.

VI. Accomplishments

- DCAP has completed a comprehensive quantified assessment of the Cannonsville Reservoir Basin.
- DCAP has an operational goal of reducing phosphorus by 10,000 kg/year.
- A management plan for each of DCAP's components is now being developed and implemented.
- Increasing reliability in accounting for different types of non-point sources of dissolved phosphorus in different parts of the Cannonsville basin.
- Ability to communicate how land use, soil, and management factors affect non-point source phosphorus loadings, via maps and charts.
- Community stormwater systems have been inventoried by GPS and has been converted into a GIS data layers for incorporation in to the county wide system. This data can be provided in the form of maps or software to local communities to make decisions on stormwater management. Meetings have already begun with local communities.

- The Planning department can now provide the technical support to communities in developing, implementing and maintaining their comprehensive stormwater management plans in the context of their Comprehensive Community Plan.
- Comprehensive plans are in various stages of development from just beginning to completed with the assistance of grant dollars.
- Stormwater management practices are being installed in three communities with funds from CWC, Army Corps of Engineer, and the Environmental Protection Fund.
- The Department of Public Works has purchased a vacuum truck for maintaining stormwater practices, using funds from CWC and the county.
- Inventory of county roads and structures for stormwater have been converted in to a GIS format from GPS data. This information will be incorporated into the umbrella of the SWAT model under development.
- DPW has completed bench scale laboratory testing to test the efficacy of tire chips in retaining soluble phosphorus in storm water. The results are encouraging with up to a 40% reduction in soluble P.
- Manure has been identified as the primary source of phosphorus and pathogens.
- Phosphorus excretion reductions through precision feeding and forage system management have been quantified and practices implemented.
- It has been demonstrated that phosphorus reductions may be accomplished with a neutral or positive impact on the finances of the farm.
- Precision Feeding and Forage Systems Management have been developed under the New York State Agriculture Environmental Management (AEM) Program umbrella. Precision Feeding and Forage Systems programs are being incorporated into the statewide AEM program.
- DCAP agriculture components are being discussed as an example of how non-point sources may be addressed under the TMDL umbrella.
- A study on the suitability of soils for OWTS has been completed indicating that at least half of the systems installed prior to 1990 are likely to fail.
- Organized an effective partnership and institutional framework from villages to the federal agencies.
- Outreach regarding the purposes and accomplishments of DCAP locally and with partners at the state and federal level is ongoing.

DCAP is demonstrating that a locally led watershed program is economically frugal and comprehensively effective in protecting water quality

VII. Continuing Work/Goals

- Continue monitoring, modeling and science for the purposes of local decision making support, evaluation and documentation of reductions for the purposes of reaching phosphorus reduction goals.
- Begin monitoring of the Trout Creek basin of the Cannonsville.
- Begin monitoring on a lowland farm.
- Based on priorities developed from comprehensive stormwater management plans and information generated from models, identify specific storm water projects for implementation and seek appropriate funding.

- Complete development of basin SWAT model needed for decision making and the generation of the impact of practices on phosphorus loading.
- Development of Comprehensive Stormwater Management Plan by communities in the Cannonsville Basin and extend to Pepacton and Susquehanna Basin.
- Assist communities who wish to develop a Stormwater Protection Plan for the purposes of acquiring a waiver from Section 18-39 of the rules and regulations.
- Develop and implement a comprehensive maintenance plan for stormwater structures.
- Identify and prioritize projects for implementation.
- Implement projects contingent upon contractor and funding availability.
- Secure funding to implement forage system management pilot farms and document the reductions net nutrient accumulation on farms.
- Extend implementation of Precision Feeding to more farmers and the feed industry representatives utilizing the human and financial resources of the WAP where appropriate.
- Continue the development of software to support precision feeding and forage systems and its integration with Cornell's crop ware software.
- With funding, inventory all town roads for the purposes of identifying key areas to address stormwater and provide technical support and training for town staff on the importance of managing roads to minimize phosphorus loading.
- Begin maintenance of stormwater systems with vacuum truck and documentation of phosphorus reduction.
- DPW - Find funding to extend and conduct work on the use of tire-chips as a medium to treat stormwater for soluble phosphorus retention. Two tasks are at hand. 1.) Evaluate different tire chip physical characteristic for their effectiveness in retaining soluble phosphorus. 2.) Test tire chips as a medium in the field for capturing soluble phosphorus. 3) Evaluate.
- Work with the state to improve coordination of state activities with initiatives under DCAP that could be implemented at the same time.
- Capitalize on funding from CWC for stormwater management projects and funding from the state related to economic development that could lead to synergistic combination for both water quality and community development.
- Advance DCAP as a model/example/case study for rural communities, agriculture and businesses to adopt for NPS management.
- Secure match funding for the Stream Corridor projects the Delaware County Soil and Water Conservation District need to implement.
- Improve collaboration and coordination with CWC and WAC to maximize efforts.

VIII. Projects Funded

Delaware County has invested in protecting water quality and its economic concerns. Delaware County clearly recognizes and appreciates the numerous grants received for the development and implementation of DCAP. Without them we could not accomplish what we have. We have received grants from: Watershed Resource Development Act funds ($1,685,500), Safe Drinking Water Act ($1,221,000), Environmental Protection Fund/Bond Act ($51,195). DOS Enhanced Master Planning and Zoning Incentive Award Program: $15,000 to Delaware County, $15,000 to Village of Walton. Small Cities grants have also been awarded.

CWC grants awarded to communities in the Cannonsville Basin under the Stormwater Retrofit program contributing to phosphorus reduction. These grants not only assist communities but also directly contribute to the goals of DCAP.

- Village of Walton two projects: $304,170: The county facilitated the acquisition of funding for match from US Army Corps WRDA funds and state Environmental Protection Fund (EPF) funds for this project. $450,000 for a second stormwater project.

- Village of Delhi: $513,657: The county facilitated the acquisition of funding for match from the US Army Corps WRDA funds and state EPF funds for this project.

- Village of Hobart: $75,000.

- Delaware County Department of Public Works (DPW) for County Route 6 in the Hamlet of Bovina Center: $562,500: $187,500 match provided by US Army Corps WRDA funds awarded to the county. Second, DPW project $168,500 for maintenance of stormwater structures through the purchase of a vacuum truck matched $51,728 by the county.

- Village of Stamford: $196,000.

Delaware County looks forward to a continued partnership for protecting water quality and our economic and social needs.

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IX. Appendices

Appendix A

Phosphorus Reduction Goal

Developing the Operational Goal:

As part of DCAP, interim reductions goals for the phosphorus levels have been developed. The average load of phosphorus (P) from non-point sources to Cannonsville from entire basin (including Trout Creek) in "typical" loading years is approximately 48,000 kilograms per year. The reduction goals serve as benchmarks against which management decisions can be guided. Based on current estimates of phosphorus loads, the interim reduction goal is 10,000 kilograms or approximately 20% of the overall phosphorus load.

Sources:

Point source discharges: Now range from 3,200 - 3,600 kg P per year.

Non Point Sources:

Cattle: Currently it is estimated there are approximately 13,000 cattle in the Cannonsville Basin. Allowing for size and age, the total P from these animals is estimated, using two different sources of phosphorus excretion predictions, 220,000 kg/year to 345,000 kg/year. If it is assumed the loss from the farms is in the range of 10%, the corresponding range of total loss of phosphorus would be 22,000 kg/year – 34,500 kg/year at 10%. This would then account for up to 70% of the target loading.

Forested areas: From the Shaw Rd monitoring site, 0.162 kg TP/ha/year is the average of the five years of monitoring. The estimated forest land area in the Cannonsville Basin is ~70,000 ha, therefore the total phosphorus load from forested areas is 11,300 kg/yr.

Urban runoff: Unfortunately only limited sampling of stormwater has been conducted in the Cannonsville basin. Three simple but different methods were used by Steve Pacenka, of the New York State Water Resources Institute, to estimate the average loading of phosphorus from urban areas. All three produced about the same load for Walton, N.Y., estimating an "average" loading rate for urban areas or 1.38 kg/ha/year. It is assumed that the area is about 1,013 ha (Brown et al) then the total annual loading of phosphorus becomes: 1.38kg/ha x ~1,013 ha = 1,398 kg P/year.

Septic Systems: The amount of phosphorus originating from septic systems is very difficult to estimate the amount that actually reaches the streams. However, the work of Larry Day (2001) shows that most of the septic systems in the Cannonsville reservoir basin do not meet current standards of design. Furthermore, the soils in the Delaware County are unfavorable for residential on-site wastewater treatment. The soils are generally shallow with a high water table or underlying impervious fragipan. Consequently, a substantial

fraction of the total amount of phosphorus (and pathogens) originally in the wastewater could be conveyed to adjacent watercourses. The total load of phosphorus that passes through septic systems is estimated to be 6,257kg P/year (Day 2001). It is unlikely no phosphorus reaches watercourses from septic systems. It is equally unlikely that all the phosphorus would be conveyed to water. Day (2001) state that the percentage of total phosphorus reaching water courses from septic systems is likely to have the range of 15%-35%. Assuming this range, the amount of phosphorus reaching watercourses attributable to septic system sources would be between 939 kg P/year and 2,190 kg P/year with the average 1,600 kg P/year.

As shown above, farming is the dominant source of phosphorus while stormwater and septic systems contribute a far lesser load (less than 10%). Controlling stormwater and septic sources remains important because they are also major sources of other contaminants, especially pathogens. Therefore, reduction goals for stormwater, septic systems, and farming of 2000 kilogram, 1000 kilogram and 7000 kilogram, respectively are plausible and constitute the overall reduction goal of 10,000 kilograms.

The following is one simplified example of how phosphorus will be reduced. The work conducted under DCAP has shown that phosphorus excreted from animals can be reduced by as much as 33% by controlling the phosphorus content in the feed. If it were assumed that a reduction of 25% can be achieved on half the farms by reducing the phosphorus content of the feed, then the total estimated loading would be reduced from 220,000 kilograms to 192,500 kilograms per year, a reduction of 27,500 kilograms per year. If, for design purposes, it is assumed that 10% of the phosphorus applied to the land as manure enters the watercourse, then the reduction achieved would be 10% of 27,500, or 2,750 kilograms per year. This one reduction represents a third of the desired reduction of 7,000 kilograms per year.

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Appendix B

Agency Acronyms

A&M	NYS Department of Agriculture and Markets
BoS	Delaware County Board of Supervisors
CCE/DC	Cornell Cooperative Extension of Delaware County
CWC	Catskill Watershed Corporation
CWT	Coalition of Watershed Towns
DCCoC	Delaware County Chamber of Commerce
DCPD	Delaware County Planning Department
DEC	New York State Department of Environmental Conservation
DED	Delaware County Department of Economic Development
DEP	New York City Department of Environmental Protection
DOH	New York State Department of Health
DOS	New York State Department of State
DPW	Delaware County Department of Public Works
DWA	Delaware County Department of Watershed Affairs
IDA	Delaware County Industrial Development Agency
NRCS	United States Department of Agriculture Natural Resources Conservation Service
SWCD	Delaware County Soil & Water Conservation District
USEPA	United States Environmental Protection Agency
WAC	Watershed Agricultural Council
WAP	Watershed Agricultural Program
WRI	New York State Water Resources Institute

Appendix C

Abbreviations and Acronyms

AFO	Animal Feeding Operation
AGNPS	Agricultural Non-point Source Model
ARS	United States Department of Agriculture/Agriculture Research Service
BMP	Best Management Plan
BOD	Biological Oxygen Demand
CALSINMPWT	College of Agriculture & Life Sciences Integrated Nutrient Management Program Work Team
CFNMS	Comprehensive Farm Nutrient Management System
CNCPS	Cornell Net Carbohydrate & Protein System
CNMP	Certified Nutrient Management Plan
CPSC	County Phosphorus Study Committee
CREP	Conservation Reserve Enhancement Program
CSSG	County Scientific Support Group
CST	Conventional Shallow Trench
cuNMPS	Cornell University Nutrient Management Plan Software
CUNMPS	Cornell University Nutrient Management Plan System
CWT	Coalition of Watershed Towns
DCAP	Delaware County Action Plan
DOQQ	Digital Ortho Quarter Quad
EPF	Environmental Protection Fund
FAD	Filtration Avoidance Determination
FSA	Farm Service Agency
GIS	Geographic Information System

GPS	Global Positioning System
GWLF	Generalized Watershed Loading Function
HMP	Highway Management Plan
HRU	Hydrologic Response Units
MOA	Memorandum of Agreement
N	Nitrogen
NPS	Non-Point Source
NURP	National Urban Runoff Program
NYC	New York City
NYSAEM	New York State Agricultural Environmental Management
OWTS	Onsite Wastewater Treatment System
P	Phosphorus
PMP	Pavement Management Plan
PS	Point Source
RUNQUAL	Modeling Program
SCMP	Stream Corridor Management Plan
SDWA	Safe Drinking Water Act
SEQRA	State Environmental Quality Review Act
SMP	Stormwater Management Practices
SPDES	State Pollutant Discharge Elimination System
SPPP	Stormwater Pollution Prevention Plan
SWAT	Soil and Water Assessment Tool
SWTR	Surface Water Treatment Rule
TMDL	Total Maximum Daily Load

TPAS	Town Planning Advisory Service
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WEAP	Watershed Environmental Assistance Program
WRDA	Water Resources Development Act
WWTP	Wastewater Treatment Plant

Appendix D

Acknowledgements

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New York State Department of Environmental Conservation
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United States Environmental Protection Agency
Watershed Agricultural Council
Watershed Agricultural Program