DCAP

Delaware County Action Plan

Linking

Economic Vitality,

Water Quality,

and Sound Science

Progress Report
Department of Watershed Affairs
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Executive Summary

Comprehensive Management Program

DCAP is the only comprehensive management program for watershed protection under local auspices in the New York City watershed. It represents a novel attempt to protect water resources, based on land management, through scientifically and economically sound governance based on local democracy. DCAP operates within the framework of state and federal laws in full partnership with the agencies representing those governmental levels. The novelty of the program raises many technical questions regarding legal and administrative requirements, organization, communications, authority and responsibility, standing, finance, and accountability especially to local constituents. Cornell through WRI is providing technical support for such challenges as DCAP matures in its operations.

Coordinating and Administering DCAP

The Department of Watershed Affairs provides overall coordination and administrative support for the activities in the County. The investment in DCAP is now substantial. About $5 million of County funds have so far supported DCAP. At least that much has also been obtained in external funds. For these funds the institutional and programmatic support of the NYSDEC, NYSDOH, NYSDAM and other partners in the watershed program must be acknowledged. The DEC in particular has long taken the position that the substantial federal and state investments in DCAP is further justified by the extension of experience and knowledge gained to other watersheds in New York State.

Three years ago, Delaware County orchestrated a watershed-wide meeting of the five Counties. This meeting eventually led to the reformation of a Watershed-wide, West-of-Hudson, Technical Advisory Group (TAG). In part through sharing the benefits of DCAP, TAG seeks to strengthen representation and capacities of all the Counties in watershed management.

Beyond the New York City Watershed, the Upper Susquehanna Coalition has adopted the multiple barrier approach from DCAP. Precision feed management is also being adopted in the Susquehanna Basin and elsewhere. International interest in DCAP was demonstrated through an invitation to present DCAP's program at a Rural Economy and Land Use (RELU) workshop in the UK in 2005. DCAP continues to share understanding with RELU principals from Imperial College, the University of East Anglia at Norwich, and the Westcountry Rivers Trust in the UK.

Local Government Role in Water Quality Protection

The accomplishments of DCAP demonstrate capacities to successfully manage land uses and nonpoint sources of contamination. DCAP therefore demonstrates the critical role of local government in protecting water quality. The federal framework of water law has traditionally not recognized local governments as partners in environmental management. This lack of specific recognition is reflected in the MOA. Nevertheless, the MOA is intended in spirit and letter to incorporate a partnership of all levels of government in pursing its watershed objectives. Experience subsequent to the signing of the MOA has clarified and demonstrated the capacities and interests of the various federal, state, New York City and watershed levels of government. This experience is a basis for an integrated partnership, which more fittingly incorporates the responsibilities of watershed communities. Delaware

County is now seeking this more explicit recognition, and hence standing, as an important institutional step to better secure protection of water quality.

DCAP Accomplishments

This document represents a snapshot in time of the ongoing DCAP program through its components:

- Economic Development;
- Planning;
- Precision Feeding Program;
- Pathogen Management;
- Stream Corridor Management;
- Monitoring and Modeling;
- On-Site Septic System Program;
- Highway Management; and
- Stormwater Management.

Continuing Goals

The future goals in the last section of this document will insure the continuing success of DCAP. Further, the ever increasing capacities of local agencies will continue to work toward water quality protection measures at the grassroots level while building ownership of the issues and providing for economic prosperity. DCAP continues its role of coordinating its water quality programs within the context of FAD goals.

Key principles in effective watershed management, from the perspective of the US EPA, are partnerships, geographic focus and sound management techniques based on strong science and data. All DCAP components are based on these principles.

From the Beginning

A major criterion for Filtration Avoidance under the EPA Surface Water Treatment Rule (SWTR) is that the water supply system "must establish and maintain an effective watershed control program to minimize the potential for contamination of source waters by Giardia and viruses". This criterion was well met by the MOA, to which Delaware County was party. The MOA serves as a surrogate for "written agreements with landowners in the watershed" as required by the SWTR. In compliance with the New York City Watershed Rules and Regulations under the MOA, Delaware County developed and adopted the Delaware County Action Plan. This plan echoes the MOA in its dual aims of protecting the integrity of the New York City Water Supply and furthering the economic vitality of the County's communities.

The Delaware County Action Plan (DCAP) is a locally managed comprehensive watershed program. Comprising community and agricultural social, technical, legal and scientific issues regarding protecting the region's drinking water supply, it addresses its goals through the efforts of highly capable County staff, academia, and the NYS Water Resources Institute. Within the New York City Watershed, it assists in integrating the programming of the Watershed Agricultural Program, Catskill Watershed Corporation and other partnership programs under the Memorandum of Agreement in its strategic plan. In the Susquehanna River Basin of Delaware County, nutrients, sediments and pathogens are successfully addressed that includes DCAP implementation below the City impoundments on the Delaware River. Internationally, DCAP is lauded as a successful watershed program, and proposals are underway to emulate its organization and program.

DCAP has achieved a great deal in less than six years. This is due to the support of the Delaware County Board of Supervisors and the capability of the local agencies. The story of it's creation is a remarkable one.

Locally-Led Action Plan for Delaware County

Coordinated by the Delaware County Department of Watershed Affairs, the Delaware County Action Plan (DCAP) is a locally led, multi-agency watershed program. It was established September 1999. Subpart 128-83 of the New York City Watershed Rules and Regulations prompted its creation. This section mandates that a Comprehensive Plan be developed in phosphorus-restricted basins. At that time, the Cannonsville Reservoir did not meet the guidance value of 20 µg/L, hence its basin was restricted.

However, with encouragement of the Delaware County Board of Supervisors, the New York State Water Resources Institute (WRI) and the County departments developed a Comprehensive Plan that in form and substance exceeded the requirements of the regulations. The plan registers Delaware County's capacity for self-government within the framework of the

Watershed Agreement. DCAP also reflects the County's long-standing experience and leadership in water quality management.

Water Quality Programs in Delaware County

Departments in Delaware County have undertaken water quality programs over several decades. In the late 1970s and early 1980s, Delaware County participated in the Model Implementation Project (MIP). This Cannonsville watershed project was funded with more than $6 million in federal funds. The MIP initiated major monitoring and modeling studies of the basin. Also in the 1980s, the County Departments and agencies took the lead in a USDA funded East Sidney Lake Hydrological Unit project for New York. This project examined farm management practices and on-site wastewater systems with respect to their potential impact on water quality. Funds for this project were obtained through a proposal written by WRI.

When NY City released its draft Watershed Rules and Regulations in September 1990, Delaware County undertook the lead role in responding to the draft on behalf of farmers in the Watershed. County staff, representing the Soil and Water Conservation District, Cornell Cooperative Extension and the Planning Department, worked closely with leading farmers. Most of the farmers were from Delaware County. The County also led in establishing and administrating the Coalition of Watershed Towns (CWT) through the leadership of Perry Shelton, Supervisor of the Town of Tompkins, to represent communities and residents in the watershed. Delaware County staff provided the administrative support particularly through the Planning and Economic Development Department.

WRI provided funds and technical support both for farmers and for the CWT in the early 1990s. Given WRI's long standing association with the County, the Board of Supervisors requested the assistance of the Institute in responding to Section 18-83 of the Watershed Rules and Regulations. This section required the County develop a Comprehensive Plan. The Chairman of the Board, Ray Christensen, required that the plan have sound scientific credentials and solid institutional standing. Regarding the latter, a great effort was made from the outset to involve County and watershed partners as a critical aspect of the creation and eventual adoption of DCAP. From the earliest phases of the work, the DEC was an important advocate. Apart from the technical studies, considerable capital was invested in multi-agency consultations and meetings. This foundation is reflected in the multi-agency committees that continue to assist and support DCAP. Projects are also conducted in cooperation with watershed partners. The Board of Supervisors demonstrated its commitment to DCAP and to protecting water quality when it created the Department of Watershed Affairs and appointed a Commissioner.

Taking the Initiative

DCAP and its projects are consistent with, and complementary to, the Safe Drinking Water Act, the Clean Water Act, Filtration Avoidance Determination issued to NY City by the US EPA, the NYS Nonpoint Source Protection Program, and the NYS Agriculture Environmental Management Program

(AEM). It also complements the NYC Watershed Program. The NYC Watershed Protection and Partnership Council (WPPC) acknowledged DCAP for its efforts in phosphorus reduction during its five-year review of the landmark MOA between watershed communities and NYC Department of Environmental Protection (DEP). DCAP quantified watershed methods show how to allocate Total Maximum Daily Loads (TMDLs) loads for all significant nonpoint sources. DCAP methods are also applicable to Confined Animal Feeding Operations (CAFO) compliance.

DCAP Mission

DCAP's mission is to assist Delaware County's residents, farmers, businesses, and communities in meeting water quality restrictions and objective without loss of economic vitality. Its management components on sustainable communities, precision feed management, stream corridor management, monitoring and modeling, stormwater management, highway runoff, capacity building and onsite septic systems constitute a balanced and comprehensive watershed protection program. It is especially motivated by New York City's restrictions on phosphorus discharges and prospective TMDLs. Therefore, its first priority was the quantified reduction of phosphorus loadings to the Cannonsville Reservoir. Management practices under DCAP also encompass other public health priorities such as trihalomethanes (THMs), turbidity, and pathogens. Bioavailable phosphorus supports the growth of algae in the reservoir, which in turn can produce THMs. Given that much of the organic particulate fraction in the reservoir is related to algae, reductions in phosphorus loading will be helpful in relation to turbidity. In its controls of phosphorus DCAP also reduces sediment loadings. Stormwater treatment and stream corridor management is another barrier to contaminants reaching streams and hence the reservoir.

Many nonpoint sources of pathogens are also sources of phosphorus. For example, improved management of onsite wastewater disposal as endorsed by DCAP will reduce risks of pathogen emissions to streams. DCAP's advocacy of composting as a livestock manure management option recognizes the effectiveness of composting in killing *Cryptosporidium* oocysts.

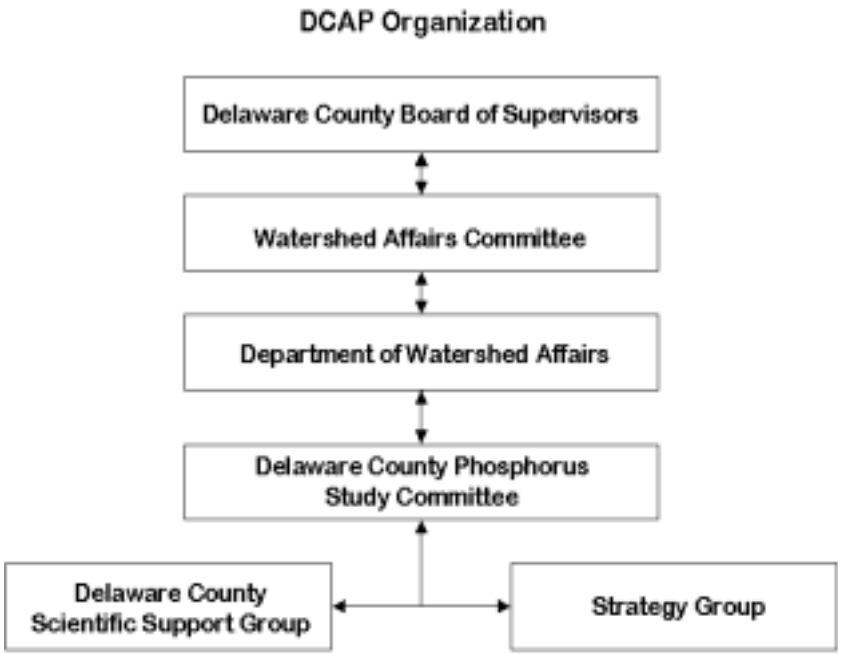
Local Initiatives Program

Local Initiatives Programs (LIPs) refer to specific watershed management programs conceived at the local level that are:

1. In keeping with the anti-degradation principles outlined in the City's Long Term Watershed Protection Program, and
2. have the potential to substantially enhance the effectiveness of existing programs within the City's watershed.

These initiatives include practices or programs that reduce excess phosphorus and other pollutants of concern from entering surface waters, and eventually entering the City's reservoirs. In keeping with FAD program goals, the origin of such pollution may be agriculture, highways, suburban stormwater, septic systems and other nonpoint sources.

LIPs offer an opportunity to



strengthen the City's Long Term Watershed Protection Program, the FAD, watershed partnerships and local stewardship. They integrate water quality protection measures through existing legal, political and technical institutional mechanism.

Vision: Maintain the existing high quality water supply while supporting the environmental integrity, rural character and economic sustainability of the watershed region by engaging and empowering local communities with the long-term stewardship of the watershed.

Goal: To provide the funding and technical assistance for local government to take control and responsibility for watershed management.

Objectives:

- Enhance water quality protection with local empowerment in decisions affecting water quality with improved support for businesses and the local economy;
- Strengthen the effectiveness of the MOA;
- Better integrate existing local arrangements and programs into the protection of the water supply;
- Improve coordination, communication and collaboration across the West of Hudson;
- Increase integration of programs with basin specific or existing water quality standards; and
- Build expertise and capacity within agencies.

LIPs are active in the watershed at the regional, county and municipal levels. These programs are intended to utilize existing administrative arrangements, such as the Catskill Water Corporation (CWC) and the Watershed Agricultural Council (WAC) as appropriate. However, the CWC and WAC represent a different level of watershed protection.

Barriers for Nonpoint Source Pollution

DCAP favors a basin-wide phosphorus balance through quantified and aggregated phosphorus reductions. Emphasis is given to controls at the sources of contaminants such as septic systems, the collection of hazardous and toxic materials, and the initial production of manure by animals. This is a first barrier for preventing pollution. A second barrier is the landscape such as farm fields or highways and community stormwater systems. A third and final barrier is the stream corridor. Implementation across all three barriers provides some redundancy and accommodates uncertainties and variations inevitably associated with nonpoint sources. It is a scientific challenge to account quantifiably for nonpoint source controls as they are implemented across each of these barriers. There can be a lag of many years before water quality sampling validates the effectiveness of the management with confidence. Therefore, DCAP has developed sound scientific surrogate measures of the effectiveness of DCAP, including comprehensive monitoring and modeling. This quantified understanding will also guide iterative adjustments in management decisions and policies over time.

Program Implementation: Key Local Government Agencies

Implementation of DCAP takes place through the following local government agencies.

- ***Soil and Water Conservation Districts*** were created by New York State law to provide for conservation of the State's soil and water resources, prevent impairment of rivers and streams, assist in the control of floods, protect the tax base, and protect and promote the general welfare of the people of the State. Individual SWCDs are created by each County Legislature, with oversight from a County-appointed Board of Directors. Delaware County's SWCD was created by a resolution in 1946, under Chapter 883 of the Laws of 1945, and designated by the Board of Supervisors in 1989 under resolution 42, as the county planning, management and implementation agency for all nonpoint source water quality programs.

- ***Planning Department*** – In 1966, the Delaware County Planning Board (CPB) was created by a resolution of the Board of Supervisors. It was charged with studying the physical, social and

economic needs and conditions of the county, and to prepare a plan for its orderly development. The CPB guided, and had oversight of, the Planning Department, which consisted of a director of planning and secretary in the mid-1970s. Recognizing the need to provide planning assistance to the County's 30 municipalities, the Town Planning Advisory Service (TPAS) was proposed by the current director, funded in 1975 and developed as a partnership with the CPB, the Olive B. O'Connor Foundation and six Delaware County communities. The Service would provide guidance, ideas, technical information and materials to the town planning boards for the development of a plan for the future of each town. The TPAS continues with 26 of the 29 Delaware County communities participating.

- ***Department of Economic Development*** was established in 2000 through Section 204 of the County Law, Resolution No. 195. The Department assists county residents through their Agri-Business Microenterprise Program, a Main Street Revitalization Program, and a Micro-Enterprise Business Program.

- ***Department of Public Works*** was established in 1984 by the Board of Supervisors under local law No. 9, and the Highway Department was incorporated into the department. Responsibility for the administration, operation and maintenance of the county landfill and refuse collection system was also included.

- ***Cornell Cooperative Extension (CCE)*** is part of New York State's Land Grant University at Cornell University. Extension work was first acknowledged in New York in 1894. In 1914 each U.S. Land Grant institution created a Cooperative Extension Service under the Smith-Lever Act. The local extension association was established in 1913 and operates under a memorandum of agreement with Cornell University to provide educational programming. Core programs are funded by, and through, Delaware County. CCE continues their credible work providing technical and managerial expertise to assist farmers meet their objectives.

DCAP works in an integrated way, with regional, state and federal partners, such as the Catskill Watershed Corporation, NYC Department of Environmental Protection, the Watershed Agricultural Council, the Upper Susquehanna Coalition, the NYS Department of Environmental Conservation, NYS Department of Health, NYS Department of State, NYS Department of Transportation, NYS Department of Agriculture & Markets, NYS Soil & Water Conservation Committee, Cornell University, Syracuse ESF, U.S. Environmental Protection Agency, US Department of Agriculture and the Army Corp of Engineers.

The Watershed Plan

Monitoring and modeling provides a credible scientific foundation for identifying management options and for evaluating the subsequent adoption and implementation of management practices. Specific management practices fall within principal DCAP components which together fully account for sources of phosphorus and other associated contaminants. The components encompass both community and farming sources.

DCAP proceeds through committees addressing policy, science and management. A collaborative partnership, DCAP addresses all significant nonpoint contaminant sources in the basin to meet water quality objectives, including satisfying allocations (to meet prospective TMDL objectives).

A short-term goal is to establish a comprehensive watershed plan for all significant nonpoint sources in partnership with communities and residents, and regional, state and federal partners. A long-term goal is to assist the county's residents, farmers, businesses, and communities in meeting water quality objectives without sacrificing economic vitality. Two objectives are to reduce:

(i) Contaminants from their individual sources; and
(ii) Total load of phosphorus, basin wide, by 10,000 kg/year.

To verifiably meet specific water quality objectives such as the TMDLs, requires management aims and results be quantified. This is a primary reason for the scientific basis of DCAP.

These management options are evaluated within their watershed-wide context through comprehensive monitoring and modeling to provide a sound scientific basis for decision-making and evaluation. The primary watershed model is the Soil and Water Assessment Tool (SWAT).

DCAP Program Summary

Five key procedures apply to DCAP programming:

1. Established, and is based, upon a credible and sound scientific foundation using extensive monitoring and modeling;
2. Conducted cooperatively with the partners to the New York City Watershed Agreement, and complements and enhances other watershed programs;
3. Led locally, and continues to develop technical capacities at the local level;
4. Fosters voluntary participation and management by local governments, landowners, residents and businesses; and
5. Developed transferable concepts and principles for watershed management to other New York City basins and beyond.

DCAP invests significant resources in scientific and technical studies. As a result, understanding and knowledge has been established of the magnitudes of the sources of phosphorus and how they can best be managed. Scientific understanding equally aids in the evaluation of the results of decisions made through DCAP. A fundamental premise of DCAP is that management to achieve water quality objectives must be consistent with the economic interests of its communities and residents. Options that are lowest in cost are more likely to be sustained. If those options also confer some economic advantage, then their sustained adoption is also far more likely. An outstanding demonstration of the effectiveness of combined environmental and economic benefit in animal production is Precision Feed Management.

In the sections following, components of DCAP are discussed. They are: Economic Vitality; Planning Tools; Agricultural Environmental Management; Stream Corridor Management; Monitoring and Modeling; and Infrastructure. Finally, the Legal and Administrative Framework will be explored, and goals for future successful DCAP programing will be enumerated.

Economic Vitality

The MOA specifically recognizes the need for economic development in the watershed as a basic element of the agreement. The three principal components of the MOA: Land acquisition and easements, the Watershed Rules and Regulations, and the approximately $350 million in funding for economic-environmental partnership programs with the watershed communities, have a major economic impact on the watershed. To this date that impact has not been scientifically evaluated. Nevertheless, the compatibility of watershed protection and economic development is also a fundamental assumption of the Delaware County Department of Economic Development. Since its inception, this Department has sought to:

- Encourage traditional economic and industrial development in the County outside the NY City Watershed; and
- Foster environmentally friendly initiatives in Watershed communities and businesses.

The low income level and unfavorable economic condition of Delaware County means that strengthening its economy is essential socially and politically. The Department serves this need through grants, business counseling and informational services. Of primary importance to the well being of communities in the County is the Main Street Revitalization Program. In 2004, for example, the Department awarded nearly $200,000 in grants to assist thirty-five small businesses. These grants fostered a total investment exceeding $1 million. The businesses have pledged to retain or create almost 200 jobs. Additional support is provided to businesses through one-on-one counseling, assistance in business planning and computer training. Although these ventures represent successes, an overriding need is to gain a soundly based understanding of the economic impact of the MOA and accordingly to determine most viable economic options for Delaware County in meeting its dual objectives.

Historically, tourism has been a major component of the Delaware-Catskill economy. This importance was specifically recognized in the West of Hudson Economic Development Study for the Catskill Watershed Corporation. This important study was the major task agreed to in the MOA in meeting the economic objectives of the MOA. Under the MOA $500,000 was provided for the study. Its goal was to “assist the WOH communities to achieve their economic, social and environmental goals which are consistent with the City’s water quality objectives and the Watershed Regulations, and reasonable administrative costs”. The study specifically recognized the value and appropriateness of tourism as an economic activity in the Delaware-Catskill watershed. Unfortunately, the debate prompted by a major venture in the watershed manifests widely varying views and even opposition to tourism in the watershed. There is a critical need to refresh the consensus represented by the MOA on economic development, and tourism as an historically vital part of the watershed economy.

Economic Development Strategy

The guiding principle of the 1997 Watershed MOA is that, “watershed protection and economic development are compatible.” A healthy environmental watershed requires good economic health. Responsible economic development and projects create new job opportunities for local residents without detriment to the water quality goals of the MOA. Delaware County, in its role as a responsible steward of the NYC West of Hudson Watershed, has taken this fundamental principle to heart.

As stated in the West of Hudson Study, "the well-being of the watershed depends upon the economic health of the surrounding area." It was this recognition that led the proponents of this study to advocate for the pursuit of economic development activities in areas "just" outside the Watershed. The development of these "adjacent centers of employment" will provide jobs for Watershed residents without substantial effects on the Watershed.

The Delaware County Industrial Development Agency and the Department of Economic Development have concentrated their efforts on establishing new industrial parks in areas outside the Watershed as a means of attracting new businesses and creating new jobs for Watershed residents, without impacting water quality within the Watershed. Of the areas of focus, two (Deposit and Sidney) were specifically named within the West of Hudson study as having potential for being developed as "adjacent centers of employment", and two (Hancock and Davenport) are in the only towns in Delaware County that are not in the NYC Watershed.

The communities within the NYC watershed are attractive as places to live, work and visit. Unfortunately, they have been subject to significant economic decline. This has created a major need for renovation and repair in most of the villages and hamlets, and was the primary economic development recommendation contained with the West of Hudson Study. The Department accordingly is promoting a revitalization program to expand opportunities for retailers, specialty services, tourism, and high-technology businesses. Encouraging growth within these communities, as opposed to elsewhere in the watershed, consolidates impervious areas and facilitates focused measures to protect water quality. Diffused growth is less amenable to pollution prevention.

Main Street Revitalization

A primary aspect of the County's economic strategy is Main Street Revitalization in partnership with watershed partners, including the Catskill Watershed Corporation and the Delaware County Chamber of Commerce. A pilot program funded entirely with County funds was initiated in 2002 and 2003. Over that period fourteen projects were

Main Street Revitalization

Good Cheap Food is a "whole-foods" store with a café and bookstore owned by Faiga Brussel Shaw. Located at 53 Main Street, in the Village of Delhi, the building sits in a very prominent location. Faiga Brussel Shaw was a recipient of a Main Street Revitalization Pilot Program grant, which was administered through the Delaware County Local Development Corporation in cooperation with Delaware National Bank. Mrs. Shaw's project consisted of repainting and repairing (rotten wood) the exterior of the building, as well as the restoration of the sign at the top of the building. The appearance of the newly painted building shows a renewed sense of confidence for all Main Street businesses.

approved resulting in the creation of 25 new jobs, the establishment of seven new businesses, and a $250,000 investment in the County's main streets (see examples of Main Street Revitalization Projects on this page and page 8).

The success of this program attracted the support of New York State, which provided funding to continue the program in 2004 and 2005. Through the first half of 2004, the Department provided assistance to twenty main street businesses. This created ten new businesses, an expansion of services/products at an additional six main street businesses, the creation/retention of 104 jobs and a private sector investment of over $800,000.

In August 2005, the Delaware County Department of Economic Development announced the approval of a further 12 grants through its third round of funding under its Main Street Revitalization Program. Six of these grants were to new businesses. In total, the 12 business plans will create or retain about 50 jobs and invest almost $200,000 in renovations to their buildings. This makes the total businesses assisted to be sixty in number. Overall, the program has encouraged businesses to invest over $1.5 million in main streets of the County. To date the total number of jobs created or retained amounts to over 250. An example of such accomplishment is the Avalon Moon retail emporium on the Delhi's main street.

Delaware County E-Center

In an attempt to encourage the establishment of new environmentally compatible businesses and jobs within the Watershed, the Department is spearheading efforts on behalf of the Delaware County e-Center. The e-Center is governed by the newly formed Catskill Development Foundation under the auspices of the Delaware County Chamber of Commerce. Senator John Bonacic secured $450,000 in state funding for construction of the Center. As Jim Thomson, Chairman of the Catskill Development Foundation observed, "The e-Center is a small business incubator and 'one-stop-shop' for economic development and tourism services that will help grow new businesses in a nurturing environment to create new jobs and be part of a

Main Street Revitalization

RK's, a grocery store owned and operated by Ruth Marshall, is located in a very prominent building on Main Street in the village of Franklin. Ruth Marshall was a recipient of a Main Street Revitalization Pilot Program grant administered through the Delaware County Local Development Corporation in cooperation with NBT Bank. Ms. Marshall's project consisted of finishing siding the left side of the building, removal of old paint, reconstructing the deteriorated trim on the face of the building, painting the front of the building white with green shutters and trim and replacing the crumbling stone slab sidewalks with concrete.

larger, economic diversification strategy for Delaware County." The Delaware County e-Center will therefore serve as a regional small business incubator to accelerate the growth and success of new and existing entrepreneurial companies, with a particular focus on the development of high tech and technology dependent small businesses. To aid in the attainment of this goal, the Delaware County e-Center will promote "e-Inclusion" by providing these businesses with access to the latest in computer and telecommunication technology, which is otherwise unavailable in Delaware County. An additional component of this initiative is to educate existing businesses in e-commerce applications.

Tourism

Tourism is historically a leading economic activity in the Delaware-Catskill area. By the end of 19th century, hotels and bed and breakfast accommodation catered for multitudes of tourist to the Catskill and Delaware County area. In recent decades, this historical important industry has declined. However, as promoted in the West of Hudson Economic Development Study, there are current efforts to revive this industry as a foundation of the economy of the area. Unfortunately, these efforts have been marred by opposition that appear not to understand the historical place of this industry in the area's economy. This lack of understanding is especially betrayed by opposition being grounded on objections to "changes in community character" or "secondary growth" that tourism would purportedly lead to.

Economic Status of Communities in the New York City Watershed

A compelling unmet need is to evaluate how the watershed communities are satisfying the economic goal of the MOA. The three primary instruments of the MOA: the Watershed Rules and Regulations, the land acquisition and easements program, and the approximately $350 million in funding for economic-environmental partnership programs with the watershed communities, all have very major economic impacts on the watershed. It is apparent that some impacts are favorable and others less so. Surprisingly, despite the need to understand these impacts, and to provide for the possibilities of making adjustments, no economic study has been conducted. Hence, we are ignorant of the extent to which farms and communities are impacted by the implementation of the MOA. This question has a critical importance beyond the watershed. Therefore, it is a recommendation of the highest priority that a comprehensive, cumulative economic impact study of the MOA be conducted.

Planning Tools for Water Quality Protection

Overview

Planning capacity to meet water quality objectives is substantially developed in Delaware County. Nonpoint source management depends upon land management. Delaware County has, in common with other counties in New York State, an impressive array of planning and management techniques. Over the past decade these techniques have increasingly taken water quality aims into explicit consideration in local decision-making. Principal techniques to protect local water supplies include: comprehensive planning; SEQRA; zoning; subdivision regulations; and site plan reviews.

Since 1975, the Delaware County Planning Department has assisted communities in the county through the Town Planning Advisory Service (TPAS). The O'Connor Foundation originally funded TPAS. Today, twenty-six of the twenty-nine Delaware communities participate in TPAS. The need to protect water in the Delaware and Susquehanna River Basins, that comprise the county, has greatly amplified the technical complexities of local land use decisions.

The County Planning Department also contributes to DCAP through its close working partnerships with other county departments and with WRI. An important example for DCAP is the comprehensive assessment and prioritization of needs of the local and public highways. The Planning Department, in conjunction with the Department of Public Works, proposed the creation of a Delaware County Highway Management Plan (HMP).

County Planning Board

The Delaware County Planning Board (CPB) was created by a resolution of the Board of Supervisors in 1966 as per New York State General Municipal Law Section 239. The CPB was "charged with studying the physical, social and economic needs and conditions of the county and to prepare a plan for its orderly development."

Three primary activities of the CPB have remained relatively constant throughout the years: 239 Reviews, Agricultural District Reviews, and the CPB's involvement in the guidance and oversight of the TPAS. During recent years, the organization and development of a county-wide Comprehensive Plan has been an added duty of the CPB.

Water quantity and quality depend upon the land. Because land management is local, water quality and quantity protection depend on local action. All local agencies in Delaware County, including the Planning Department, serve in the Core Planning Group for DCAP, and are instrumental in preparing and guiding implementation of its agenda.

Section 239 Reviews

General Municipal Law Section 239 provides county legislatures with the authority to empower the CPB to review certain zoning and subdivision actions that may have intercommunity or county-wide considerations. The CPB has been granted this power and the 239 reviews have been a constant activity of the CPB, since its inception in 1966. In the past, 239 Reviews represented only a small portion of a typical monthly agenda, whereas today they constitute approximately one third of the monthly meeting. The remainder of the agenda consists of an hour-long county-wide comprehensive plan work session and the review of general Planning Department business. This general business category allows the Planning Director an opportunity to discuss current concerns with the Board, and to seek their input, advice and direction when dealing with Department issues such as special projects, budget, and personnel.

Agricultural District Reviews

Twelve agricultural districts comprise much of the farmland throughout the County. To be considered an agricultural district, at least fifty-one percent of the land must be used for agricultural purposes. Changing conditions require the districts to be reevaluated and amended every eight years. Based on the information collected, some parcels are removed from the districts, some remain, and others are added. The "amended" district is then mapped and its characteristics are tabulated according to various agricultural categories. This information is gathered by Department staff, presented to the County Agriculture and Farmland Protection Board, and then presented to the CPB for review. Once approved, the matter is referred to the Board of Supervisors (BOS) for final approval.

In the past, CPB had an Agriculture Committee, comprised of three members of the Board. This Committee, along with the County Agriculture Board and a representative from State Department of Agriculture and Markets, conducted site visits to the district being reviewed and made their recommendations to the BOS. These field trips offered a first hand look at how the County is changing, and provided an additional informed point of view from which to make recommendations to the BOS. Presently, the CPB reviews rely on field observations and site inspections conducted by the County Agriculture & Farmland Protection Board. A 2003 amendment to the State Agriculture and Markets law requires each county to perform an annual review period for all active agricultural districts. The annual review period gives agricultural landowners in all districts and opportunity to be considered for addition to an agricultural district, prior to that district's scheduled eight-year review. The annual review period procedure is very similar to the eight-year district reviews and is handled in the same manner.

Town Planning Advisory Service

During the introductory years of the Town Planning Advisory Service (TPAS) an intimate relationship between the County Planning Department and the CPB existed. The CPB provided goals and objectives to the department in general, more specific direction to Department staff, and monitored TPAS activities. The staff implemented the goals and objectives of the CPB through program activities in the field. Department staff provided monthly summary reports of the planning activities in participating communities and requested input and direction from the CPB. As more towns adopted land-use regulations, the incidence of projects requiring 239 Reviews increased, speaking directly to the success of the TPAS program. Due to an abundance of 239 Reviews, the CPB has had to shift focus towards the review of county-wide projects/proposals, but they are still available for guidance and support on County, State, Federal and Department issues.

Department members are well recognized within their towns and serve as "conduits of communication"; a factor, which can be very helpful. In summary, the board occupies an important position

between the public and the Department, whether for decision making, insulation from political issues, or assisting with a range of planning projects. Services offered through TPAS are :

- Current planning;
- Comprehensive planning;
- Grant writing;
- Mapping (GIS);
- Wellhead Protection;
- Municipal Projects;
- State Environmental Quality Review Act (SEQRA) Compliance;
- Watershed technical assistance
- Training outreach;
- Zoning; and
- Delaware County Planning Board Liaison.

Current Planning Projects

Assistance to communities is provided with the drafting, administration and revision and interpretation of local land use regulations for a variety of topics. These include subdivision, zoning, and site plan review; road take-over and driveway specifications; mobile homes; cell and wind towers; junkyards and dump control; sanitary codes; critical environmental areas; floodplain; historic districts; and right-to-farm agriculture (see tables on pages 14 and 15 for planning activities undertaken in towns and villages).

County Comprehensive Plan

Work on the county-wide comprehensive plan began in 2001, utilizing a NYS Department of State grant award. The Department began the planning process by holding each of their monthly meetings in a different municipality throughout the County. Regular business was still performed as usual and a portion of each meting was dedicated to the comprehensive plan; specifically the issues pertaining to the municipality/region in which the meeting took place.

This issue identification process continued into 2003 at which time the CPB shifted their efforts towards the establishment of planning goals for the numerous county affiliated departments and organizations. This process entailed a monthly presentation schedule where department officials from each organization spoke to the Board, presenting an overview of their department activities and anticipated future needs. The Department has divided themselves into task force focus groups for each of the topics to be covered by the county-wide plan. In 2004, the task forces worked with Department staff to draft and assemble a draft document for review.

The staff also work with communities on all aspects of comprehensive planning, including: consultant selection, survey preparation, public meetings, Census research, preparation of action plans and implementation schedules, report writing, and mapping.

Grant Writing

Working with communities, planning staff assist in obtaining financial support for a variety of municipal projects such as updating local regulations, landfill closures, centralized and decentralized sewage treatment works, planning assistance, septic system maintenance, and transportation solutions including covered bridge rehabilitation and industrial access.

Mapping Services

The Department's GIS staff provides a variety of mapping services, including data analysis and display using Geographic Information Systems (GIS). This computerized database management system is designed to manage and analyze spatial data. The system of layered maps produced by the system can be examined in many ways. Current uses of the GIS database by the Department are:

- Parcel / subdivision review;
- Site plan development and review;
- Land use review;

Land Use Regulations and Planning Activities in Delaware County - January 2006

Towns	TPAS	Comprehensive Plan	Subdivision Regs	Site Plan Review	Zoning	Sanitary Code	Dump Control Law	Mobile Home Regs	Road Take-Over Policy	Soil Profile Analysis	Critical Environmental Areas	Historic District	Source Water Plan	Cell Towers	Wind Turbines	Access to Town Highway	Junkyards	Highway Management Plan	Right to Farm
Andes	X	2003	E/U-2006	E/U-2006	E/U-2006		X	X	X	X		X	I	2001			X	I	X
Bovina	X	2003	1997	X	1996		X	X	X			X				X			
Colchester	X	2003	2004				X									X			
Davenport	X		2002				X		X	X							X	I	
Delhi	X	2002	1989	X	2002		X	X	X	X						X			
Deposit	X	2003	2005	P-2006				X											
Franklin	X	E/U-2007	1990	X	E/U-2007	X	X	X	X	X			X	X					X
Hamden	X	2000	E/U-2006	2001			X	X		X				X					X
Hancock	X	E/U-2007	1995			X	X										X	I	
Harpersfield	X	2002	E/U-2006	I-2007		X	1987	1977	X	X				2001	X	P	E/U-2007		X
Kortright	X	2002	E/U-2006			X	X		X	X				X				I	X
Masonville							X		X								X		
Meredith	X	2006	E/U-2006				X	X		X				X	P-2006		X		
Middletown	X	I-2007	1989	X	2000		X	X	X			X				X			
Roxbury	X	2002	1988				X			O	X	X	2004	X	X				
Sidney	X	2002	1990	X	2003	X	X	X	X	X				X	X		X		
Stamford	X	2001	X	1996			1988		X										1990
Tompkins	X	2004	1994			X	X			X							X		
Walton	X	E/U-2006	1986	E/U-2006	E/U-2006			X					I-2006						X

X Adopted
P Proposed

O Official policy, not yet adopted into regulations
I In progress
E/U Existing regulation, update in progress

Dates indicate when tool was last updated

All Towns and Villages of Delaware County have adopted the New York State Building and Fire Codes (International Codes) and Flood Damage Prevention Local Laws

Land Use Regulations and Planning Activities in Delaware County - January 2006

Villages	TPAS	Comprehensive Plan	Subdivision Regs	Site Plan Review	Zoning	Sanitary Code/Sewer Use	Dump Control Law	Mobile Home Regs	Road Take-Over Policy	Soil Profile Analysis	Critical Environmental Areas	Historic District	Source Water Plan	Cell Towers	Wind Turbines	Access to Town Highway	Junkyards	Highway Management Plan	Right to Farm
Delhi	X	2000	1997	X	X	2001	X	X				X							
Deposit					X	X	X	X											
Fleischmanns	P-2006				1997			X				X	2004						
Franklin		2003										X							
Hancock	X	1984		1988	1992	X		X									X		
Hobart	X	2003	1992		1994	X		X					1989						
Margaretville	X	E/U-2007		X	2005		X	X					2004						
Sidney	X	X	X	X	X		X	X									X		
Stamford	X	E/U-2006		X	2005	2001	1962	1969				1978					2002		
Walton	X	2000	2001	E/U-2006	E/U-2006	X	X	X											

X Adopted
P Propose

O Official policy, not yet adopted into regulations
I In progress
E/U Existing regulation, update in progress

Dates indicate when tool was last updated

County-wide Projects - Delaware County Action Plan (DCAP), Comprehensive Plan and All-Hazards Plan (in progess), Solid Waste Management Plan (SWMP), Comprehensive Emergency Management Plan (CEMP), Ag and Farmland Protection Plan

- Examination of natural features;
- Municipal infrastructure (highways and buildings); and
- Public water supply protection

A satellite-based navigation system, a Global Positioning System (GPS) is also employed by the Department to collect location data that can be analyzed with the GIS. GPS is employed for the following applications:

- Urban (transportation, utility infrastructure, roads and utility lines);
- Agriculture (field characteristics and chemical applications); and
- Modeling, navigation and emergency services.

Wellhead Protection

Wellhead protection is a proactive approach to minimize the potential for contamination at the drinking water source. Wellhead studies have been completed in a number of Delaware County municipalities, including Roxbury, Fleischmanns, and Margaretville. This information, once interpreted, can be used to develop protection plans to provide safeguards to municipal water supply sources (wells and springs), satisfying NYS Department of Health requirements as the village of Margaretville has done.

Municipal Projects

The Department plays an active role in assisting communities with the development, funding and administration of projects, including: planning, infrastructure, Main Street revitalization, and parks planning.

SEQRA Compliance

New York's State Environmental Quality Review Act (SEQRA) requires all state and local government agencies to consider environmental impacts equally with social and economic factors during discretionary decision-making.

This means these agencies must assess the environmental significance of all actions they have discretion to approve, fund or directly undertake. SEQRA requires the agencies to balance the environmental impacts with social and economic factors when deciding to approve or undertake an "Action".

How does SEQRA work? If an action is determined not to have significant adverse environmental impacts, a determination of non-significance (Negative Declaration) is prepared. If an action is determined to have potentially significant adverse environmental impacts, an "Environmental Impact Statement" is required.

The SEQRA process uses the EIS to examine ways to avoid or reduce adverse environmental impacts related to a proposed action. This includes an analysis of all reasonable alternatives to the action. The SEQRA "decision making process" encourages communication among government agencies, project sponsors and the general public.

The law was implemented by regulations which were fully effective on November 1, 1978 and revised effective June 1, 1987 and January 1, 1996.

SEQRA applies to all state or local government agencies including districts and special boards and authorities whenever they must approve or fund a privately or publicly sponsored action. It also applies whenever an agency directly undertakes an action. Applicants who seek project approval or funding may be responsible for preparing an EIS.

When actions consist of several steps or sets of activities, the entire set must be considered the action, even if several separate agencies are involved. Segmentation of an action into components for individual review is contrary to the intent of SEQRA. No agency involved in the overall action can make a final decision until the SEQRA process is completed.

Watershed Technical Assistance

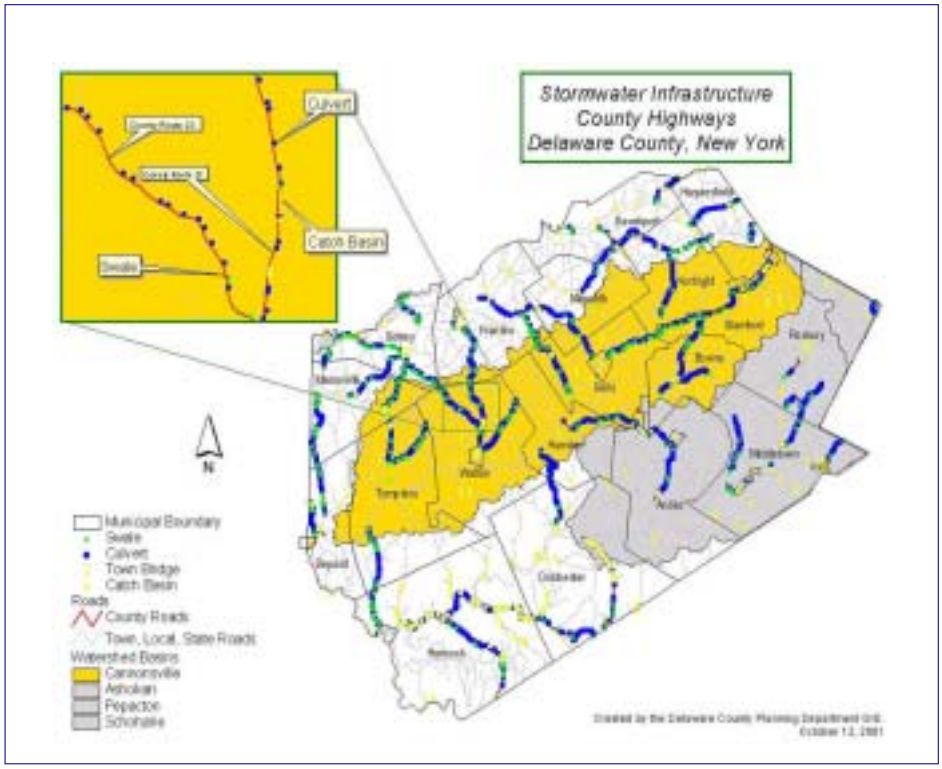
Municipalities of Delaware County are situated within one of two major watersheds (Delaware and Susquehanna) that are subject to varying degrees of control from the NYC Department of Environmental Protection, the Delaware River Basin Commission or the Susquehanna River Basin Commission. Through the TPAS, the Department keeps communities aware of current regulations, delivers applicable program information, and helps towns and villages maintain local planning authority from these outside agencies.

Highway Management

In conjunction with the Delaware County Department of Public Works (DPW), the Planning Department has developed a program to assess and prioritize local and county public highways and infrastructure conditions. The program will ultimately develop into the creation of a Delaware County Highway Management Plan (HMP), which will be consistent with the MOA, the NYC Water shed Rules and Regulations, and DCAP. It is the intent of the HMP to meet the needs of the County and its towns in terms of water quality and highway management by establishing long term guidance. The HMP can then be used to assist local leaders in prioritizing capital improvements.

There are approximately 270 miles of county roadways. The 17 towns in the watershed have expressed the desire to develop Highway Management Plans. Delaware County recently received a Safe Drinking Water Act grant under which five towns will begin developing the HMPs in 2006 with the balance completed in 2007 and 2008. In the past, Delaware County has conducted several highway maintenance inventories for the County maintained roadways. From the County inventory, analysis of the data collected has shown that there are problematic areas. This knowledge has been beneficial to the County in respect to the maintenance and repair of the existing infrastructure.

Based on the results from the work conducted for Delaware County roads, it would be beneficial for towns to develop their own HMPs. With the creation of a plan, stormwater controls such as Stormwater Management Plans would be ad-



dressed specifically for each town. Hence, one of the components within DCAP, highway runoff, is being addressed.

The HMPs are developed using the following components:

- Conduct and inventory and evaluate the existing highway infrastructure;
- Evaluate roads as conduits of pollutant delivery;
- Implementation of stormwater management practices in areas identified in the evaluation phase as a significant pollutant contributor;
- Develop an institutional relationship with the towns to ensure continued implementation of the maintenance program.

County information collected includes drainage ditches, culverts, and catch basins. The location of each piece of infrastructure is recorded by using Global Positioning Systems (GPS). The infrastructure collected will then be inventoried and analyzed using Geographical Information Systems (GIS) software. Preliminary analyses elated to highway stormwater runoff will include land use, slope, and condition of infrastructure. Further analyses and future recommendations will be developed as funding becomes available.

The County Planning Department anticipates writing additional grants for 2005 to continue the inventory and data collection in three more towns The County will continue to pursue additional grant funding to continue with the analysis and assist the Planning Department and DPW in the development of local HMPs.

Training and Outreach

Information is regularly supplied to planning boards, town boards, and zoning boards of appeals on current planning projects and community concerns. TPAS planners provide informational updates from agencies such as the Department of State (land use and SEQRA), the Department of Environmental Conservation (Phase II stormwater), and the Department of Health (septic/water). Additional department outreach is provided through annual training sessions sponsored by the County Planning Board and administered by Department of State staff, on a variety of current land - use topics regularly faced by local review boards.

Zoning

Zoning is a tool "to promote the public health, safety, morals, and general welfare. Its principal aim is to foster the most appropriate land uses. This is achieved by dividing the land into districts according to specified characteristics. Benefits include:

- Protection of private investment in land;
- Managing or guiding economic growth;
- Protecting a community's natural resources;
- Preventing undesirable land uses or blight; and hence,
- Conserving or protecting land and building values.

Authority for zoning is delegated to Towns and Villages under Town Law §263 and Village Law § 7-704 respectively. Zoning authority is customarily exercised through Village trustees or Town boards and should accord with their comprehensive plans.

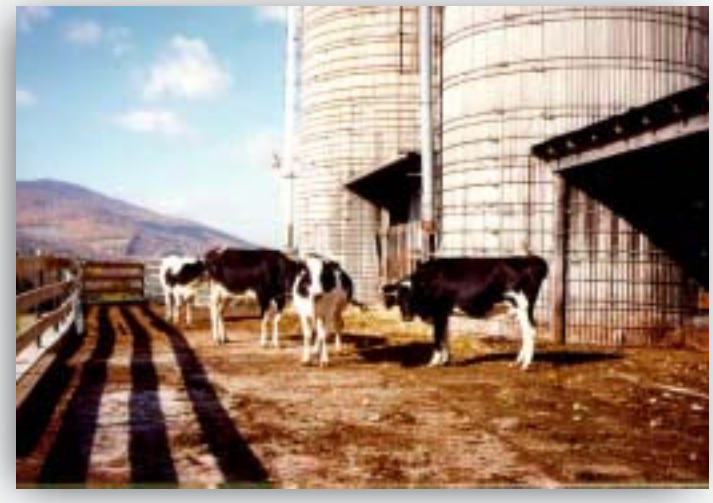
Overall Trends

It is clear that the Board has taken an increasingly proactive stance on county planning issues since the 1980s and early 1990s; writing letters, passing resolutions, and remaining involved in regional land use issues.

One increasingly common task of the CPB in recent years has been the review and recommendations of locally significant sites to the State and/or National Historic Register. The Board offers their support to assist those individuals seeking to be listed on the registers in the form of a letter of support. Other significant examples of the CPB commitment to the vitality of the area include the review of a NYS Power Authority proposal for the Marcy-South transmission line, various planning and management programs in the Upper Delaware Scenic River Basin, and the increasingly important land use matters associated with the NYC Watershed.

Agricultural Environmental Management

Nutrient management on dairy farms is the most critical aspect of water quality protection in New York State. Sound nutrient management requires calculated consideration of all the components of the nutrients to, across, and from, the farm in the form of its various inputs, flows, retentions, and outputs. Of these components, the most critical is the input to the farm in the form of feed to animals. Delaware County introduced methods to mange such inputs of nutrients in the early 1990s. This was achieved through methods of precision feeding developed at Cornell University. Precision Feed Management (PFM) has now proved to be a substantial pollution prevention program as implemented on dairy farms in Delaware County through DCAP.



The implementation of PFM under DCAP is carried out by Cornell University Cooperative Extension of Delaware County and is comprised of three integrated components; 1) an on farm PFM planning process; 2) Educational outreach to farmers and the feed industry, and 3) research and development to support the PFM planning process. PFM is based on a sound scientific understanding of nutritional requirements of animals and crops. Studies and field demonstrations carried out through DCAP show that:

- It is possible to significantly reduce the import of purchased feed nutrients onto the farm and in doing so reduce the accumulation of nutrients (particularly phosphorus) on dairy farms;
- Manure nutrient excretions (nitrogen and phosphorus) can be reduced through diet management;
- Through improved forage management, it is possible to recover and recycle nutrients on the farm, hence reducing the risk of losses of nutrients to ground or surface water as well as reducing edge of field nutrient and sediment losses via erosion, run off and leaching.
- Farm productivity and viability can be maintained or improved.

PFM is proving to be a highly cost-effective way of limiting risks of pollution by phosphorus and nitrogen and mutually benefits the farmer and the environment.

Other important studies undertaken under the auspices of DCAP that will be discussed in this section are:

- Critical control points for phosphorus reduction across the farm using three barriers,
- Pathogen study results from the Susquehanna River Basin of Delaware County, and
- Options for manure management.

Precision Feed Management (PFM)

Precision feed management is, at its simplest level, doing a more precise job of balancing dairy cattle diets for animal requirements and utilizing homegrown feeds in an effort to reduce overfeeding and importation of purchased feed nutrients, particularly phosphorus (P), and accumulations of these nutrients in dairy farm soils. Due to the integration of forage production and feeding of dairy

cows, PFM also includes management of forage production to allow for high levels of homegrown feed in the diet.

History of PFM in Delaware County

In 1999 Delaware County and Cornell Cooperative Extension of Delaware County began a 2-year, 4-farm grant funded research demonstration project in Delaware County in the Cannonsville Reservoir to determine what levels of P were being fed and what measures might be taken to reduce P feeding. This project was developed and implemented under the auspices of DCAP for Watershed Protection and Economic Viability, the County's comprehensive watershed management strategy. Results indicated that there was wide range of phosphorus overfeeding in lactating dairy cattle diets, with an average of 41 percent overfeeding. Strategies to reduce P feeding were implemented on two farms, resulting in an average reduction in feed P intake of 25 percent, manure P excretions of 33 percent, and mass P balance (farm P imports minus farm P exports) of 50 percent. The success of this first project set the stage to implement PFM on more farms.

Current PFM project

Building on the success of the first PFM project, Delaware County Department of Watershed Affairs and Cornell Cooperative Extension of Delaware County applied and received additional grants to expand PFM in the Cannonsville Reservoir Basin to more farms from January 2004 to January 2007, with full focus on implementation. This current PFM project is designed to be the second phase of PFM, where details of larger scale implementation are worked out. A third phase is anticipated for the future that would implement PFM on all participating dairy farms in the Delaware County. The current PFM project will work closely with the feed industry, and support them in making dietary changes on the farm, rather than having the PFM specialists take over the nutritional management on the participating farms.

The present PFM project is coordinated by Cornell Cooperative Extension of Delaware County under a subcontract with Delaware County. All on-farm PFM specialists are Cornell Cooperative Extension of Delaware County staff members, with technical support from faculty from the Department of Animal Science at Cornell University. The PFM project is funded primarily with a federal grant from the U.S, Army Corps of Engineers, with smaller matching grants from the Catskill Watershed Corporation (CWC), the Watershed Agricultural Council and the United States Department of Agriculture/ Agriculture Research Service.

Like the previous PFM project, the current PFM project is limited to dairy farms within the Cannonsville reservoir basin. There have been special water quality grant funds available for water quality improvement projects in the Cannonsville Basin due to the high phosphorus concentrations in the Cannonsville Reservoir and its importance as an unfiltered drinking water supply for New York City. Under DCAP, we are expanding the PFM project to other watersheds in Delaware County, particularly the Susquehanna River Basin under a state Environmental Protection Fund grant, which is facing increased nutrient management regulation.

PFM team staff specialists

The following are the local PFM team members from the Cornell Cooperative Extension of Delaware County staff:

- Paul Cerosaletti, MS, CCA, PAS — Precision Feed Management specialist and team coordinator
- Dale Dewing, MS, CCA — Precision Feed Management team agronomist
- April Wright Lucas, CCA, PAS — Precision Feed Management dairy nutritionist

The following faculty from the Cornell University Department of Animal Science are providing technical assistance to the PFM project:

- Dr. Tom Tylutki -— technical support and education in dairy nutrition and management
- Dr. Larry Chase — support and education in dairy nutrition and management
- Dr. Danny Fox — Nutrient management and dairy ration software development

Outcomes of the PFM project

Ultimately we hope to reduce nutrient (primarily phosphorus, but also nitrogen) accumulations on cooperating farms by reducing feed nutrient imports, increasing crop and milk nutrient exports, or both. Based on previous research we expect to find some degree of over feeding of phosphorus and potentially nitrogen (protein) in the lactating dairy cattle diets of the cooperating farms. We seek to reduce phosphorus overfeeding where it is occurring by implementing rations that meet, but do not exceed animal P requirements. We would like to improve nitrogen (protein) utilization, thus reducing nitrogen imports and manure excretions where possible as well. We anticipate increasing home-grown forage feeding levels and (potentially) reducing purchased grain feeding levels. To do this we will likely first need to improve forage production (quality and quantity). We have as a goal achieving the above without decreasing milk production per cow or decreasing income over feed costs. Where consistent with cooperating farm goals, we may try to increase income over feed costs by increasing milk production per cow. We seek to maintain or improve farm economic viability.

Throughout the course of this PFM project we will be developing a logical, documented and repeatable process to implement PFM on other farms in the future. Our goal is to develop the standard of identity for PFM as a water quality Best Management Practice.

Results of the project will be documented in technical reports and scientific papers.

Critical Control Points

The CCP program concerns the development and application of critical management points for phosphorus reductions on farms using three barriers, source, and field and stream corridor for addressing the risk of potential P contamination. These three barriers were originally proposed as the critical control points for management practices on the farm. The Watershed Agricultural Council subsequently adopted the three-barrier framework for control points. Critical control criteria for P used for determining critical control points are exclusion, containment, and controlled release. Identifying key areas on the farm contributing P, evaluating the risks using the criteria over the barriers, and monitoring management practices throughout is an objective of this task.

The dual objectives of protecting water supplies at their source (under the Safe Drinking Water Act), and restoring impaired water bodies (under the Clean Water Act) are combined inducements to quantify the economic benefits and water quality gains of best management methods. Although recent data suggests the figures may be high (Cerosaletti, personal communication), 24.3 kg P/year/1000 lbs animal weight may be assumed conservatively. In the Cannonsville reservoir basin Paul Cerosaletti, Delaware County Cooperative Extension, estimates there are between 12,000-13,000 cattle including 7000-8000 adult animals (personal communication). Therefore the estimated number of dairy cattle in the Cannonsville Reservoir Basin according to age/weight is:

- 12 000-13 000 cattle comprising 7000-8000 mature dairy and 5000 heifers.

Using two different methods to calculate the estimated phosphorus loading from cows and heifers in the watershed we estimate the range of phosphorus loading to be between 220,000 and 345,000 kg/year. Therefore the estimated range in total annual loading of phosphorus originating from manure in the basin is between five to eight times

the target total loading of 40,000 kg to the reservoir. Most of this phosphorus is retained on the farm. Field observations indicate the fraction of phosphorus measured in drainage from the farm is about 10 percent of the total originally applied to the fields (Bishop, personal communication, 2002). Therefore, if we assume this rate of loss to water as an average for all farms, then the corresponding range of total loss of P would be 22 000-34 500 kg/year. This estimated load of phosphorus to watercourses from farming is about 40-70 percent of the current loading to the reservoir of about 50 000 kg P/year.

Farms are therefore primary candidates for seeking reductions in phosphorus, in the Cannonsville Reservoir Basin, given the dominating magnitude of their total load of manageable phosphorus. Substantial progress is already being achieved by a Cornell Nutrient Management team in reducing losses of nutrients from farms to streams through precision feeding of the animals and by improved forages that enhance the recycling of phosphorus on the farm (Cerosaletti et al, 1998. and Fox et al, 2000). It is now understood that imports of nutrients to farms for intensive livestock production can greatly augment the overall nutrient balances in watersheds (Cahoon et al, 1999). The work by Cerosaletti, Fox, and other members of the Cornell team show that the contribution of imported phosphorus for small, low density farms can also be highly significant for a watershed.

The nutrient management methods applied in DCAP have proceeded in cooperation with the NYS Agricultural Environmental Management program (AEM). A key means for this interactive cooperation has been the Cornell Nutrient Management Program Work Team.

Conclusions

Critical Control Points apply to the three barriers protecting water quality from farm discharges. The barriers are the animals including the barnyard area, the fields and the streams themselves. This underlying critical control concept is now adopted in the New York City Watershed and in the Susquehanna River basin. Progress is now being made statewide through the adoption of enhanced nutrient management emphasizing the importance of the first crucial control point: animal feeding. The Cornell Nutrient Management Team is now focused especially on the second critical control point, the crops. However, less progress has been made in promoting the adoption of more systematic methods, such as spreadsheets, or quantified procedures for crucial control point analyses. This is in part reflects reservations about accepting objectively quantified water quality objectives in the farming community. An important need is to gain confidence in the value of the critical control methods by farmers and the planners who assist them. That farmers can be confident in their application of critical control measures is well demonstrated by the on-farm work of Paul Cerosaletti in DCAP.

Furthermore, the Watershed Agricultural Council has adopted the barrier basis for critical controls. The monitoring and modeling currently supported by DCAP is establishing the basis for quantifying the flows of nutrients such as phosphorus, into and across farms in terms of the critical control points. DCAP methods show that the economic interests of the farm can be sustained or even enhanced by the adoption of quantified methods. This quantification is the key next step in meeting the challenge of CAP loading targets or TMDLS as manifest by those posed by the USEPA

Chesapeake Bay Program. The Critical Control Point methods developed and demonstrated through DCAP provide an opportunity for meeting such challenges.

Pathogen Management

Pathogens have a first importance under Filtration Avoidance. Filtration Avoidance requires under the SWTR that there be "a watershed control program which minimizes the potential for contamination by *Giardia lamblia* cysts and viruses in the source water". With an EPA grant obtained through WRI, Cornell scientists working with staff of the Delaware County Soil and Water District, have studied the prevalence of *Cryptosporidium* and *Giardia spp.* in animal production in the Ouleout and Charlotte Creeks. Both of these Creeks are in the Susquehanna River Basin upstream of the water supply intakes to the City of Binghamton. Hence the risk of pathogens is also a concern in the Susquehanna. The Cornell scientists determined that more than half of the farms sampled had at least one animal shedding oocysts. The results for Giardia lamblia were higher, with ninety percent of the farmers having a least one animal shedding cysts. This work reaffirms the essential need to identify farm management practices for pathogens which are based on sound science. DCAP and the Watershed Agricultural Program have recognized that it is essential for the FAD to meet this need. They now propose to extend this scientific work to identify management options by which the two pathogens may be controlled in the New York City watershed.

Susquehanna River Basin Pathogen Study

This study began with a random selection of 20 representative farms in the Delaware County portion of the Basin. A participatory approach for selecting farms was used, supported and assisted by SWCD personnel.

Several initial meetings were held with SWCD personnel and farm representatives to design a sampling plan. Farms were selected randomly.

Figure 1 shows the distribution of the selected farms. Twenty farms were selected out of the potential seventy-four cattle operations in the target population. There is clear geographic coverage of the target population and proportional representation of the farms according to the clustering in the watershed. In addition to the geographical representation, we used demographic and management criteria in selecting farms enrolled in the study.

The selection criteria were divided into primary and secondary, based on their perceived contribution to the risk of harboring *C. parvum*. The primary criteria included herd size (small vs. large), type of production (dairy vs. beef), whether there was a stream passing through the farm (present or absent), and proximity to water bodies. The secondary

Table 1. Herd's structure of the farm included in the study.

	# dairy calves 0-6 months	# dairy calves 6-12 months	# heifers 12+ months	# milkers on dairies	Total # cows on dairies
Mean	16	13	23	60	112
Standard Error	2.05	2.551	4.04	7.36	13.86
Median	15	12	16	62	106
Mode	25	15	13	#N/A	#N/A
Standard Déviation	6.48	8.45	13.39	24.40	45.97
Range	18	26	43	84	155
Minimum	7	4	4	31	57
Maximum	25	30	47	115	212

Figure 1. Distribution of the selected farms "O" in relation to the farms in the traget population.

selection criteria included age structure of the animals on the farm, whether they are enrolled in New York State Cattle Health Assurance Program (NYSCHAP), management of new calves (open or closed herd), frequency of cleaning the calf area, and whether the farmers were interested in participating in the study. Data for these selections criteria had been collected by the SWCD under the NYS AEM Tier I and Tier II study.

The average number of calves under 6 months in the sample of dairy herds enrolled in the study was 18 calves, which was not significantly different than the mean of 17 calves that was observed in that particular cluster (Table 1). Similar observations were noticed with regard to other factors in the study which assure us of representation of herds in our sampled population.

Prevalence of *Cryptosporidium parvum*. A stratified sampling design was developed to recruit animals from farms in the study. The stratification was based on the age of the animals and design was weighted towards the higher risk group — namely, calves. At the time of farm visit we sampled all calves under 30 days, 50 percent of the heifers, and 25 percent of the cows. The cow group in the sample included milking and dry cows. The number of animals sampled from each farm ranged from 20 to 32 with a median of 23 heads.

To identify factors that might be associated with the likelihood of *Cryptosporidium parvum* and *Giardia spp.*, a questionnaire was developed. The questionnaire included factors that are reported, from our prior studies and others, to be associated with the likelihood of these two protozoa in animals on the farm.

Fecal samples were collected per rectum from all animals selected on each farm and screened at the laboratory for the presence of the two protozoa using the concentration-flotation method. In addition, fecal samples from all calves under 30 days of age were tested for evidence of infection with *C. parvum* using the enzyme-linked immunosorbent assay (ELISA). If there was a discrepancy between the floatation and ELISA tests, the samples were confirmed using the immunofluorescent assay.

Figure 2 shows the prevalence of *C. parvum, C. andersoni* and *Giardia spp.* among the cattle operations in the Upper Susquehanna Watershed. Eleven out of the twenty farms (55 percent) that were sampled had at least one animal shedding *C. parvum*. This indicates that this protozoan was prevalent among cattle operations in the Upper Susquehanna Watershed at a high rate.

Figure 3 shows the distribution of the shedding rate of *C. parvum* among the sampled cattle operations. The shedding rate ranged from 0 to 25 percent, with an average rate of 6.5 percent. Knowing that 55 percent of the farms selected in the study had at least one animal shedding *C. parvum* in the environment of Upper Susquehanna Watershed, one should be concerned because of the potential that the pathogen may enter the water supply systems of communities in this watershed.

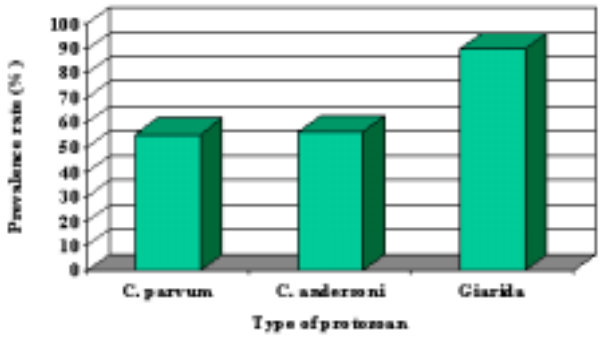


Figure 2. The prevalence of *Cryptosporidium* spp. and *Giardia* spp. among cattle farms in the Upper Susquehanna Watershed

We examined the pattern of shedding *C. parvum* among the sampled animals. The results of the analysis are shown in Figure 4. Almost all of the animals that were shedding *C. parvum* were under 45 days of age. The shedding rate among animals in this age group was 36 percent, which was significantly higher than the other age groups. For animals older than 45 days, the likelihood of shedding *C. parvum* in the manure dropped significantly. The rate also dropped significantly in comparison to animals less than 45 days of age. This finding is consistent with other studies where the conclusion was that the young calves are the highest risk group. If efforts are to be made to mitigate the risk associated with this pathogen they should focus on this age group.

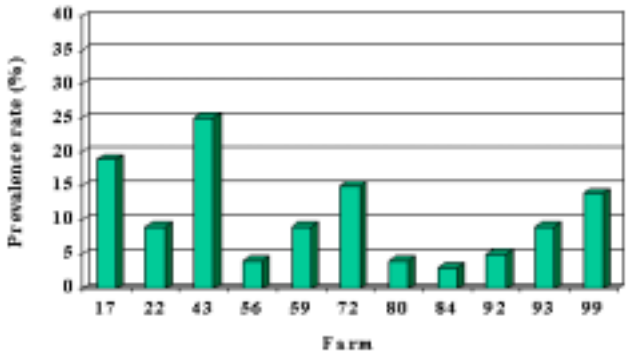


Figure 3. The distribution of the shedding rate of *C. parvum* amoung cattle operations in the sampled population.

The questionnaire included factors that had been either reported or hypothesized to predispose cattle to the risk of harboring and shedding *C. parvum*. Factors are: demographic (herd size, age distribution, and number of animals within each age group) geographic (location of the farm within the watershed, and presence of water bodies in the farm), management (housing of animals, use of colostrum, staple feed of calves), and health practices (management of calving, quarantine of animals, use of supplements). We initially evaluated the association between each of these factors and the presence of *C. parvum* in animals. The factors that were found to be significantly associated with the risk of *C. parvum* were examined together to

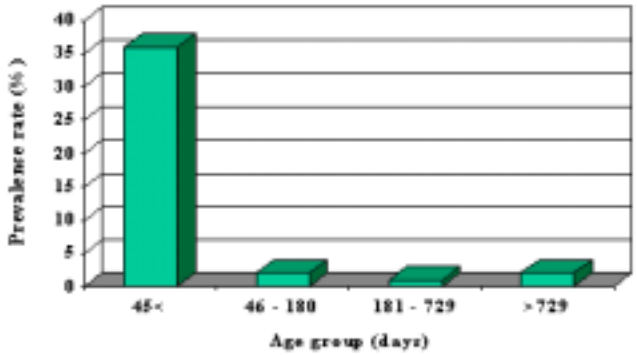


Figure 4. Ocurrence of *C. parvum* in different age groups among the sampled animals in the Upper Susquehanna Watershed.

evaluate their combined effect. We found that the likelihood of shedding *C. parvum* decreased with the age of the animal. As the animals ages, the likelihood of shedding oocyst declined (Starkey et al., 2004). In addition we found that this likelihood increased with the number of young stock in the herd, but this risk could significantly be modified by changes in calf housing. It is clear that animals at high risk of shedding *C. parvum* in the Upper Susquehanna Watershed are young calves, a finding that is consistent with what has been reported in other watersheds. Changes in the management of calf houses are likely to reduce their risk of shedding oocysts and might mitigate their potential risk of contamination of the environment.

Prevalence of *Giardia*. All fecal samples collected from animals in the study were examined for the presence of *Giardia spp*. cysts. We found that 90 percent of the sampled farms had at least one animal shedding cysts (Figure 5). The shedding rate of *Giardia spp*. cysts within farms varied between 3 — 36 percent, with an average rate of 14.7 percent (Figure 5). This prevalence rate was significantly higher than the one observed for the *Cryptosporidium spp*., and similar to the one that had been reported in the literature in other geographical areas in the U.S. and beyond.

We further examined the shedding rate of *Giardia spp*. cysts by age group among the sample animals (Figure 6). Calves below 45 days of age ha the highest shedding rate (30 percent) in comparison to the other age groups. Calves between 46 ar 150 days of age had the second highest shedding rate (25.4 percent) which was not significantly different than the younger calves. Heifers between 150 and 729 days of age, and cows (two years of age and more) had lower shedding rates (11 and 1.2 percent, respectively) in comparison to younger stocks.

The observed high prevalence of *Giardia spp*. among farms in the watershed is not surprising. It is similar to the shedding rate observed in another watershed and reported in the literature. This protozoan is known to have a zoonotic potential, and hence poses risk to the water supply systems in this watershed.

Training Potential

An added value of this study was to provide training opportunities for graduate and undergraduate students. Two graduate students, Kevin R. Kimber and Simon R. Starkey, participated in this research, and the project represents part of their Ph.D. programs. Both are DVM and received research support through our Graduate Research

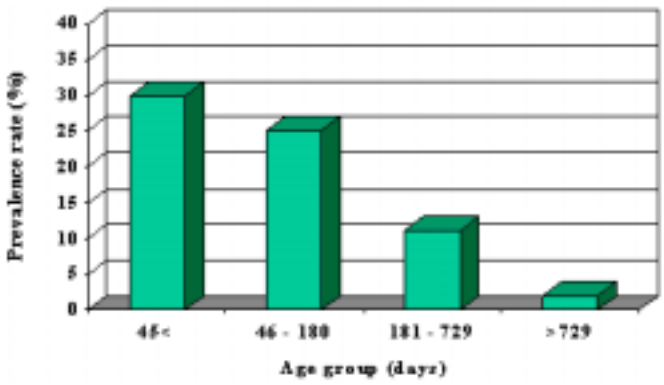


Figure 6.Shedding rate of *Giardia* spp. cysts among different age groups of animals sample in the Upper Susquehanna Watershed.

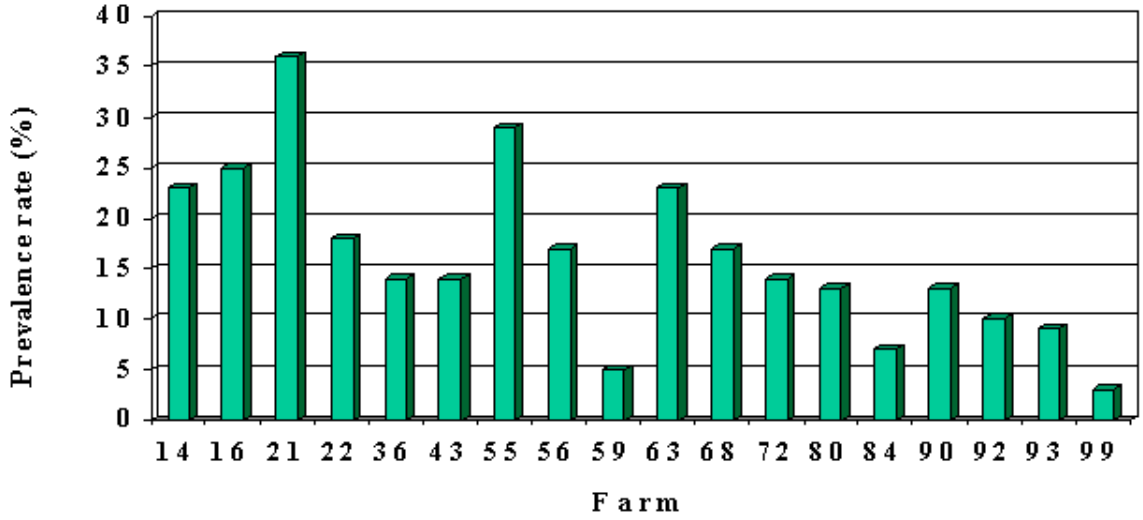


Figure 5. Within herd prevalence of *Giardia* spp. among farms sampled in he Upper Susquehanna Watershed.

Assistantship program at the College of Veterinary Medicine, Cornell University.

In addition to the graduate students, we had the opportunity to also have two undergraduate students participate in this research. Students are Dennis Slade, Philip Schissler and Ashley Anderson. It has been a productive experience for both of them to work on a zoonotic problem because Dennis Denies is enrolled in the DVM program at Cornell and Ashely was accepted at the Chicago Medical School.

Continuing Work for 2006

Evaluating precision feeding impacts on parasites is underway through a project entitled, *Scientifically-based Management Guidance for Controlling Pathogens Through Animal Health*. This project is designed to estimate the rate of occurrence of zoonotic genotypes of *Cryptosporidium* and *Giardia* in animals and the environment on dairy farms in the Cannonsville Reservoir Basin and the practices that are associated with their perpetuation. Understanding derived will allow the identification of management practices and measures to limit the occurrence of pathogens in animal populations as well as their waterborne transfer to watercourses and the reservoir.

Manure Management Options

The pollution of the Cannonsville Reservoir by phosphorus imposes a Total Maximum Daily Load (TMDL) on the Cannonsville basin. As the core purpose of the Comprehensive Strategy it represents, DCAP proposes to remedy the quality of the Reservoir as a source of drinking water. Voluntary local action with incentives will substantially reduce the load of phosphorus delivered to the reservoir. Delaware County has operationally a goal of reducing the load by 10,000 kg P/year. The challenge to DCAP is to determine how to divide the assimilative capacity of the Cannonsville Reservoir among the nonpoint sources of phosphorus in the basin. Estimates in the basin indicate that sixty percent or more of the current loading originates in animal manure. This manure potentially is a source of pathogens as well as phosphorus. Managing manure safely is therefore economically critical for farmers and other residents in Delaware County. It is also essential for the nine million people dependent upon the New York City water supply.

Delaware County has undertaken two analyses of options for basin wide manure management in the Cannonsville Reservoir Basin. The first is a broad analysis conducted by the NYS WRI, and the second a more localized analysis based on actual scenarios and costs in the Watershed. The following paragraphs contain a description of the analyses, outcomes and conclusions.

NYS WRI Manure Management Analysis

Manure management is the end component of the Whole Farm Cornell University Nutrient Management and Planning System (*Cu*NMPS). *Cu*NMPS is part of a watershed software package developed at Cornell under DCAP. DCAP adopted, and is applying, *Cu*NMPS specifically because it offers substantial economic benefits to the farmer, while achieving quantifiable reductions in the phosphorus balance on the farm. Research and its implementation on DCAP pilot farms shows that phosphorus load produced on farms can be readily reduced by over 25 percent. *Cu*NMPS is frugal to apply and implement. It provides a Whole Farm package, integrating animal and crop nutrition, soil management and water quality protection.

The annual loading of phosphorus to the reservoir now averages about 51,000 kg of phosphorus. More than 30,000 kg of this phosphorus is estimated to come from farming mainly through manure. Practical opportunities for further reductions in phosphorus loading from the other sources of phosphorus are now very limited. These sources are mainly wastewater treatment facilities, on-site septic systems, urban areas and forests. The key management question is how can the target reduction of 10,000 kg P/year be achieved? As a matter of practicality, manure management is the key to protecting the reservoir from both phosphorus and pathogens.

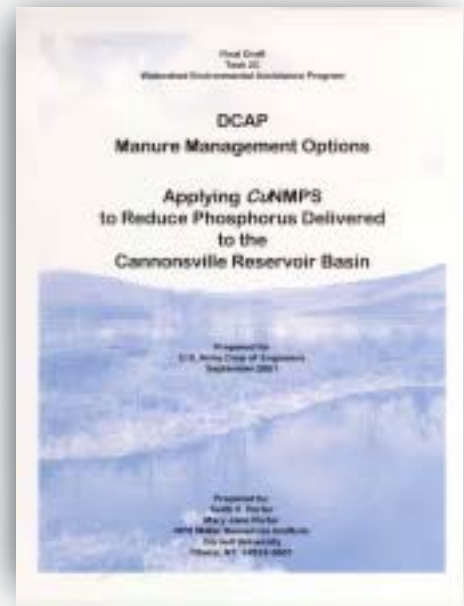
What criteria should guide the selection of manure management options? Two sets of criteria are distinguished according to the protection of

water quality or best farm management. For water quality purposes the manure should be:

- Rendered sanitary: Free of pathogens;
- Stabilized so there is no risk posed by BOD, or by offensive smells; and
- Applied to crops so the nutrients are retained and recycled in the cropped fields rather than pose significant risks to water quality.

For farm purposes the manure should preferably be:

- Pathogen and weed free;
- Economical to handle, transport and apply;
- Not a potential private and public nuisance;
- Maintain desired nutrient and soil conditions as specified by *Cu*NMPS; and
- An economic asset rather than a management cost.



In its raw state manure does not meet these criteria. A management option that does meet the criteria is composting. The Ad Hoc Task Force on Agriculture and New York City Watershed Regulations recommended, in its 1991 report, that New York City should finance an off-farm infrastructure to establish composting and redistribution of the compost. Composting is increasingly adopted as a management method because it converts what may be considered a liability into a marketable product.

There are three options for instituting a *Cu*NMPS-based composting program in the basin:

1. On-farm composting;
2. Off-farm composting in sub-regional composting facilities for clusters of nearby cooperating farms; and
3. Off-farm composting in a regional facility such as the Delaware County Municipal Solid Waste Co-Composting Facility.

Each of these options has advantages and disadvantages. An overriding consideration is the economics of an integrated composting scheme. *Cu*NMPS offers economic gains when applied by farmers. In particular, the positive economic benefits of well-managed composting operations are well indicated by two on-farm case studies. Composting can be a significant means of revenue. This depends upon creating a market for the composted product. A major advantage of the County's Co-composting Facility is that it will create a marketing infrastructure for finished compost. Good marketing will be essential. For this purpose, it is also essential that the Delaware County Manure Management Program maintain consistent quality and reliable quantity in the compost it produces and supplies.

To meet the phosphorus reduction goal, the overall recommendation is that DCAP institute a composting scheme as part of *Cu*NMPS. The scheme should include:

1. Implementing the opportunity for off-farm composting provided by the Delaware County Co-Composting Facility. Opportunities to integrate infrastructure this facility will create, including marketing, should be pursued.
2. Where opportunity and interest provides, DCAP should seek to pilot co-farm composting as part of their nutrient management through CuNMPS.
3. Examining, and if feasible, implementing, a pilot sub-regional composting facility where cooperating farms are conveniently clustered.
4. Monitoring and continued computer-based analysis of the pilot scheme.

Manure is the major source of pathogens and phosphorus in the Cannonsville Reservoir Basin. Implementing the 1991 recommendation of the Ad Hoc Task Force on Agriculture, to treat manure by composting, is the most important step that can be taken to protect the integrity of the New York City Water Supply.

Summary Recommendations. The overall recommendation is that DCAP institute a comprehensive composting program integrated with *Cu*NMPS on the farm and with the Delaware County Municipal Solid Waste Co-Composting Scheme in the County. There are two off-farm options: the County Co-Composting facility, and the establishment of local co-farm composting facilities. The latter may be located within or outside the New York City Watershed. Suggested steps to initiate the comprehensive program are as follows.

1. Develop the comprehensive County-based composting program within the infrastructure of the County Co-Composting Scheme including creating a marketing strategy.
2. Implement the specific opportunity to co-compost with the Delaware County Co-Composting Facility.
3. Co-market compost produced at other composting facilities with the County Co-Composting facility.
4. Examine, design and implement, a pilot sub-regional composting facility.
5. Encouraging and supporting individual farmers if and where they have the opportunity and interest to adopt on-farm composting within CuNMPS.
6. Monitor and scientifically evaluate and validate the effectiveness of the program.

Specific recommendations for DCAP:

- Promote the wider adoption of the whole farm CuNMPS so:
  - — The management of animal waste substantially reduces the risks of pathogens and phosphorus being conveyed by field drainage to watercourses,
  - — Precision methods are applied across the farm for components,
  - — The phosphorus surplus and risks to water quality are ascertained,
  - — The desired fraction of manure to be removed is determined with the farmer's agreement.
  - — Residual nitrogen needs created by the removal of manure from farms is compensated.
- Ensure there will sufficient incentives or revenues for the program to be adopted and sustained.
- Consider the practicality of establishing a 'Traveling composting' service for farmers. This may be performed commercially or through a public agency.
- Consult farmers and WAC to assess the individual willingness of farmers to participate in CuNMPS and a County based composting program.
- Encourage avoiding spreading manure when the risk of runoff is high such as when the ground is frozen or covered with snow.
- Assess and establish the role of the private sector in any of the components of the DCAP composting program.
- Maintain the County monitoring and modeling program to ensure sound adoption and evaluation of the efficacy of management measures considered and adopted.

Delaware County Local Analysis

Historically, since the beginning of the 20th century, livestock confinement has been a practice of providing the feed and forage while keeping the livestock contained in a barn or

pen. As a modern farming practice, it was thought to control the dietary intake of the animals, while at the same time maximize the production of meat, milk and fiber. The importation of phosphorus by using grains grown in the Midwest has produced a surplus nutrient mass balance on many Northeast dairy farms. Efforts are well underway to reduce the imports of phosphorus to Delaware County farms by fine tuning the rations fed to animals as well as improving the forage grown on these farms. One of the major drawbacks to keeping animals confined in addition to harvesting feed and forage for confinement is that the farm must also handle manure waste by containing it, transporting it and eventually disposing of it on open farm fields.

Confounding manure handling issues in the Catskills region are severely steep slopes, secondary roads and spring-fed tributaries draining toward larger streams and rivers that comprise the watershed basins flowing into the New York City drinking water reservoirs. Agriculture and forestry make up the vast acreage of this landscape. Animal husbandry practices of the past have dominated all other farming practices. Routine waste disposal practices were not felt to be environmentally damaging. Activities such as the farm disposal of manure to fields with ample vegetative barrier were thought to present little risk of nutrient runoff that would endanger the quality of these waters. However, research suggests that enough runoff occurs during springtime heavy rain events, coupled with annual snow melts, to warrant a more comprehensive manure management program.

Delaware County explored the efficacy of several manure management alternatives: transporting of manure (liquid and solid); daily spreading; on-farm composting; municipal co-composting; and the production of methane. Excess manure production was identified using GIS, existing field storage pile areas, and a phosphorus indexing tool that was developed by the nutrient management specialist employed by the New York City Watershed Agriculture Program (WAC).

The daily spread method on a cost-per-cow comparison remains one of the most economical alternatives given the large capital investment for storages and specialized equipment necessary for the other alternatives. Also, processing of manure via a digester, dewatering system to reduce odor and/or water from “as produced” manure also appears to be the most expensive and requires additional management of operation and maintenance.

A solution to handling manure used in European nations successfully that has little or no odor and is a product that is easily handled is composted manure. The composting process requires farms to collect the manure, mix with a bulking agent and turn or mix frequently. Capital expenditures in the form of equipment and infrastructure, as well as operating and management to collect and mix manure with amendments like hay or wood chips means that unless a farm has these materials available at low cost, this represents additional operation costs and is time consuming and an expensive method of handling manure. Unfortu-

nately farm gate prices continue to be problematic as strong, steady markets for agricultural goods eludes the American farmer. As a result, the least cost approach to removing a by-product, such as manure, off the farm continues to be option of choice.

Municipal co-composting exists in Delaware County, and the County has dedicated 14 percent of its composting capacity to the composting of manure. Since the co-composting process is a "water hungry" process, liquid manure provides the best opportunity for composting at the county facility. GIS data from the WAC identified candidate farms for municipal co-composting that are relatively close to the county's facility. Unfortunately, escalating energy costs have created a challenge in handling liquid manure, rendering it inefficient and too costly to be hauled any distance. To compound the challenge, there are currently no businesses identified as interested in investing in equipment.

Manure handling equipment is expensive due to the corrosive nature of raw manure. Also, the moisture content is high in all forms of manure, and as a consequence is more costly to move between distances. This issue has evolved into a major obstacle as fuel prices increase.

As the local study indicated, there is little incentive for independent operators to fill the void of compost operator or transporter in Delaware County given thin profit margins. The lack of local resources from the poorest sector of the state continues to provide challenges to manure management. Funding from outside sources is essential if any program is to succeed. The time lapse between the studies has seen fuel prices escalate and farm gate prices decline. Either analysis in today's environment leads to the conclusion that at the very least a subsidized program is necessary to get an infrastructure program underway and perhaps sustain it in the long-term. After fifteen years, the 1991 recommendation of the New York City Watershed Ad Hoc Task Force on Agriculture to treat manure by composting, still stands. NYCDEP should undertake, in partnership with Delaware County, to protect the integrity of the New York City water supply as recommended by the Task Force.

Stream Corridor Management

A stream corridor is the barrier, which most immediately protects the watercourses. The Delaware County Soil and Water Conservation District (SWCD) through its Stream Corridor Management Plans promote this protection. The basic aim of these plans are to enhance stewardship of the West and East Branches of the Delaware River and their tributaries. The New York City Department of Environmental Protection provides funding with assistance from the U.S. Army Corps of Engineers with the West Branch Plan. They have been conducted in association with DCAP over the last five years. Approximately sixty-two percent of the land parcels in the Cannonsville Reservoir Basin greater than one acre are farmed. It follows that much of the 662 miles of streams must in part drain agricultural land. Thus farmers have a major role in stewardship of the streams and tributary corridors. The recently distributed draft West Branch Delaware River County Stream Corridor Management Plan contains sixteen major recommendations. The East Branch Plan is currently under development.

Apart from the benefit for water quality, the Stream Corridor Management Plans will assist in providing the basis for sound floodplain management. They will also enhance the amenity value of the stream corridor. Hence the Plans have an economic value. An underlying tenet of the Watershed Agreement is that "watershed protection and economic development are not incompatible".

Stream Corridor Management Program (SCMP)

A significant source of water quality impairment in the New York City Watershed is urban stormwater runoff. Within the Cannonsville Basin, it has been estimated that such runoff contributes approximately 3200 kg of phosphorus per year to the reservoir (six percent of the total P load). To address this issue, the Delaware County Planning local residents, municipalities, and the Watershed Agricultural Council, stream corridors have been assessed and mapped. Protection measures are being planned and implemented through the locally developed Stream Corridor Management Program according to determined priorities and availability of funds.

SCMP is working with the following programs and agencies to supplement and enhance all water quality objectives in the Cannonsville Reservoir Basin:

- Watershed Agricultural Program (SWCD, WAC, CCE)
- Conservation Reserve Enhancement Program
- Delaware County Department of Public Works (where streams and bridges collide)
- Delaware County Planning Department (Hazard Mitigation Planning, Stormwater Management)
- Delaware County Department of Emergency Services
- Delaware County Department of Water shed Affairs
- NYSDEC (permits, funding, outreach)
- USACOE (permits, funding)
- USEPA

SCMP is using a watershed scale approach. This is similar to whole farm planning in that it looks at the watershed as a whole instead of addressing a site specific problem without assessing upstream causes of specific problems and downstream effects of mitigation or maintenance. The protocol attempts to work with a stream's natural processes. Assessments include a stream's ability to transport its sediment or bed-load, how a stream's riffle/pool sequence compares to reference conditions, and how a stream maintains/utilizes its floodplain (for example, is it accessible

and is it functioning as an energy dissipater and sediment trap during flood events). Repair of significantly damaged reaches can allow marginal downstream reaches to heal over time. Therefore, it is important to carefully prioritize impacted reaches for mitigation planning/implementation. The SCMP will be encouraging implementation of BMPs (some are yet to be identified), such as CREP and other riparian buffer initiatives which are designed to improve overall stream health.

A draft SCMP was developed for the WBDR watershed that provided a foundation for local residents, municipalities, interested organizations and cooperating agencies to enhance stewardship of the WBDR and its tributaries. The SCMP is a culmination of four years of study and assessment in coordination with DCAP.

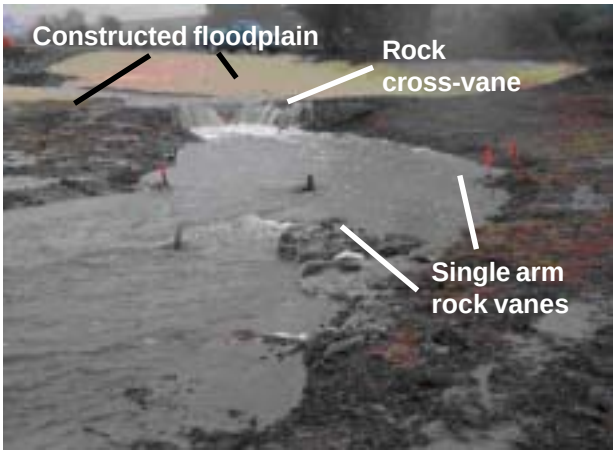
Goals and Objectives

Primary goals are to:

- Develop a practical, comprehensive Stream Corridor Management Plan for the West Branch of the Delaware River and its tributaries above the Cannonsville Reservoir;
- Provide for the construction of a natural channel stability demonstration project(s) and provide guidance for future stream management;
- Characterize, assess and address stream management issues using the natural stream channel design and other approaches; and
- Support and enhance ongoing and new education programs to increase the understanding of and appreciation for water resources management and the value of multiple objective stream management plans.

Objectives are water quality improvement (identification and prioritization of stream sedimentation sources), stream bank and channel stabilization, aquatic habitat enhancement, identification of flood potential, to liaise with other water quality initiatives and enhanced floodplain management.

Example 1 of SCMP implementation.
Looking up stream during and after construction



The West Branch Delaware River and its tributaries are the source waters for the Cannonsville Reservoir. The watershed above the Cannonsville Reservoir encompasses an area of 353 square miles with approximately 662 linear miles of rivers and streams. This predominantly forested and agricultural watershed represents a sizeable and challenging resource to comprehensively manage. Stream walkover observations and assessments suggest that the WBDR has a tendency to become shallower and wider due to increased sediment supply from excessive bank and bed erosion in the main river and its tributaries. While erosion and deposition are natural process, many land management activities can significantly increase erosion

rates that in turn contribute to increases in sediment supply. These conditions demonstrate the need for comprehensive management and stewardship by all stakeholders.

Potential Benefits

- Protection of agricultural land and public infrastructure;
- Increased stream reach stability;
- Improved aquatic habitat;
- Reduced turbidity, sedimentation and associated nutrient loading;
- Additional cover for upland wildlife
- Filtration avoidance;
- Community/interagency participation to explore solutions to a complex issue; and
- Expedited permitting for municipalities.

WBDR Status of Current Progress and Research

- Developed comprehensive Geographic Information Systems (GIS) database
  - — Historical aerial photographs (1938, 1963, 1971, 1983 and some 1943) scanned and geo-referenced to mid-1990s aerial photographs.
  - — Global Positioning System (GPS) mapped 49.5 miles of West Branch Main stem and 6.2 miles of the Town Brook sub-basin. This is a comprehensive mapping and identification of stream and bank features including riffle and pool locations, eroding banks, revetments (berms, walls, cribbing, riprap, etc.), gravel bars, debris jams, bypass channels, etc. for use in determining current conditions and to aid in prioritization for future mitigation.
  - — GPS data dictionary included for guidance on the type of information collected.
- Comprehensive field data collection
  - — Collected and analyzed extensive field data for use in determining current hydraulic geometry of the basin. This information is used to develop logarithmic hydraulic relationships that aid in prediction of bankfull flow and stream channel dimensions for a given drainage area for both assessment and design purposes. This work involves the survey of longitudinal profiles and cross-sections at selected monitoring points, and also involves two methods of sediment sample collection from the stream bed

Example 2 of SCMP implementation.

Double cross-vane structure during construction.

Near bankfull flow through the double cross-van structure

for use in determining the effectiveness of stream sediment transport. QA/QC is rigid.

- Landowner survey
  - Conducted landowner survey in two stages on the West Branch main stem and one in the Town Brook sub-basin to obtain information on management issues in the basin.
  - Information was also gathered from selected longtime landowners along the West Branch and in Town Brook with respect to stream flooding history and what, if any maintenance was performed.
- Implementation of demonstration restoration project
  - David Post farm, Town Brook Stream, Town of Stamford. This project is our flagship project. A full geomorphic design is being implemented at this site. The project Monitoring Plan provides for a minimum of three years of monitoring to evaluate design and construction effectiveness. Dave is a cooperative landowner and future tours will be planned.
- Rama Project, Town of Kortright on Wright Brook is a streambank stabilization project based on geomorphic principles. The intended purpose is to stabilize the streambanks to facilitate CREP implementation.
- Partial funding obtained for two additional projects
- Conservation Reserve Enhancement Program (CREP)
  - Authorization expires 12-31-2007
  - Stream reaches with unstable banks ineligible for CREP
  - Goal of stream program to assist WAP with stabilization of stream banks in ineligible reaches
- Outreach efforts ongoing.

SCMP Recommendations

The following recommendations provide a starting point for the long-term stewardship of the

WBDR, its tributaries and associated riparian corridors.

1. Integration of the Watershed Agricultural Program and Stream Corridor Management Program. Comprehensive integration of these programs will significantly enhance stream corridor management in the West Branch Delaware River watershed.
2. Expand technical support to the Conservation Reserve Enhancement Program (CREP). The goal of this assistance is to stabilize stream banks that are currently unstable so that they are eligible for CREP participation. Establish incentives to encourage more CREP implementation on cropland.
3. Implement a variable width buffer pilot program. In the conceptual stage, this initiative will be designed to implement buffers of varying widths along actively migrating streams and evaluate their effectiveness to further protect stream corridors.
4. Participation with the Catskill Watershed Corporation (CWC), to explore the enhancement of existing CWC programs and the development of new CWC funding program that address stream related stormwater issues, stream stewardship, public education and outreach, and stream stability issues.
5. Stream Corridor Management Plans for non-agricultural riparian landowner stewardship. The program should seek funds to provide site specific management plans.

6. Review of stream gravel issues to inform stakeholders on the relationship of gravel to streams and develop a program to scientifically manage excessive gravel deposits at identified locations.
7. Streamline stream work permitting. One goal could be the enhancement of existing permitting authority to the SWCD for implementation of approved stream management practices under its current General Permit.
8. Assist municipalities with culvert sizing and design.
9. Participation with DCAP: the program will continue to work closely with all DCAP participants to integrate the Stream Corridor Management Plan and its recommendations into all relevant components of DCAP.
10. Expand public education and outreach efforts.
11. Develop a program to perform geomorphic assessments at prioritized bridges and large culverts to assist municipalities in addressing stream flow and depositional issues.
12. Continue to work with and assist local, state and federal agencies in the area of flood hazard mitigation and flood recovery.
13. Continuation of geomorphic research/assessments at prioritized locations to further the understanding of stream behavior and how it correlates to various land-use practices.
14. Seek funds necessary for construction of streambank stabilization projects in the Village of Walton.
15. Prioritization of identified stream intervention projects.
16. Develop a process for updating the West Branch Delaware River Stream Corridor Management Plan.

East Branch Delaware River

The East Branch Delaware River (EBDR) and its tributaries are the source waters for the Pepacton Reservoir. The entire watershed is 371 square miles in area with approximately 644 linear miles of rivers and streams and is also a sizeable and challenging resource to comprehensively manage. The predominant land cover is forest. Current efforts are focused on identifying issues and concerns with local stakeholders, prioritizing locales for assessment, and identifying areas in need of intervention. A Stream Corridor Stewardship/Management Plan is being developed in coordination with DCAP and is scheduled for delivery by December 31, 2007. Comprehensive outreach is also being conducted on the EBDR.

SCMP Staff

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Monitoring and Modeling

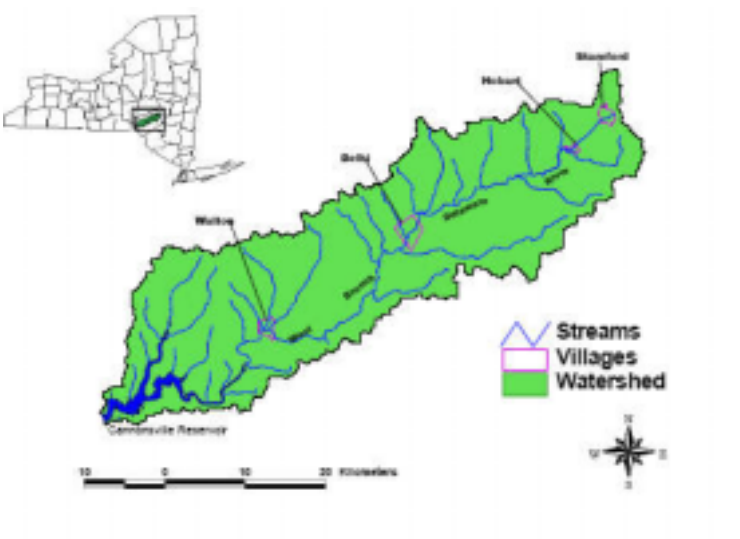
Scientific Credentials

From its outset, DCAP has sought to create and maintain solid scientific credentials for its planning and management actions. WRI is a primary means of engaging scientists in conjunction with the NYS Department of Environmental Conservation. DCAP's scientific foundation is based on comprehensive monitoring. The Cannonsville Reservoir Basin is the most systematically monitored basin of which we are aware. This is essential for DCAP's decision-making and its evaluation. To date, the results of the monitoring suggest there is a long-term trend towards lower nutrient loadings. Hence, there are grounds for confidence that the phosphorus restriction will not be re-imposed.

A new groundwater project will supplement the extensive surface water monitoring. This sampling will provide, for the first time, measurements of the quality of subsurface flows to watercourses. Mathematical modeling has suggested that subsurface flows of dissolved phosphorus are a significant contribution to the total load, hence the need to verify this hypothesis.

Extensive and intensive field studies also provide scientific understanding of the hydrological and physical processes that influence the movement of nutrients across the landscape. In particular, the R Farm has been intensively studied for many years in association with water quality monitoring conducted by the DEC. The interdisciplinary studies constitute a very substantial investment in research. Under a grant from the DEC, WRI has compiled a "compendium" to describe, integrate and disseminate this rich lore of scientific understanding.

Results of the monitoring and the field investigations are incorporated into watershed modeling. Although DCAP has applied GWLF and HSPF, the most informatively practical model to date has proven to be SWAT. The development and application of SWAT by scientists in the Cornell School of Civil and Environmental Engineering provides a detailed ability to determine and assess the distribution of phosphorus sources and the transport of phosphorus in the watershed. This is a management tool of long-term value to Delaware County. With funds provided by the DEC, WRI staff members are working with County staff to provide experience in the use of models. The goal is to foster sufficient understanding so that Delaware County is not entirely dependent upon others for expertise in watershed modeling.



Cannonsville Reservoir Basin.

Scientific support for modeling via DCAP has also included development and testing of state of the art farm and cow scale models that are being used in the Precision Feed Management Program. Specifically these include the Cornell Net Carbohydrate and Protein System model (CNCPS),

a cow scale model, and the Integrated Farm System Model (IFSYM), a farm level model. The development and deployment of these models has been critical in assessing the environmental, animal productivity, and farm economic impact of PFM on dairy farms.

Integrated Monitoring and Modeling

DCAP's scientific foundation is the comprehensive monitoring and modeling underway. Both monitoring and modeling serve a number of purposes related to water quality and the effects of land use and management programs upon it. Used together, monitoring and modeling can assist in decision-making by helping managers understand how environmental systems work and how these systems may react to changes made on the land.

Monitoring is typically used to gather information about how systems naturally operate. Objectives of monitoring might include one or all of the following:

1. Establishment of base-lines;
2. Identification of trends;
3. Quantification of processes;
4. Identification of management options;
5. Evaluation of direct changes in water quality as a result of implementation of management practices;
6. Track down of causes of detected water quality problems; and
7. Collection of data to construct, calibrate and validate models.

Due to the large amounts of time and resources needed, monitoring can only be conducted on a limited basis. As an alternative, models can be employed to simulate natural systems and provide information on what could be expected at a given site under specified conditions. Results of smaller-scale, site-specific monitoring studies can be used to construct and test models which are then applied to larger scales and/or other locations. Models can vary from simplistic, relying on very little data input, to complex with large data requirements.

Cannonsville Basin Monitoring

Current water quality monitoring efforts in Delaware County include long-term event-based sampling by DEC of the West Branch of the Delaware River (WBDR) at Beerston, a site which captures about eighty percent of the tributary flow to Cannonsville Reservoir. DEC recently began conducting event-based monitoring of Trout Creek, which drains about ten percent of the Cannonsville basin. These two stations leave only about ten percent of the reservoir's drainage unmonitored.

Another long-term event-based monitoring project has been carried out by DEC on an upland farm and a background, forested area for the past eleven years. These two small-scale (< 350 acres) sites are being used in an evaluation of the effect of Whole Farm Planning and implementation of agricultural best management practices (BMPs) on water quality. Monitoring of a lowland farm in the Trout Creek drainage basin was initiated in 2004 and water quality data will be compared to those collected at the upland farm. Water quality monitoring study is also being conducted by the DEC at the outlet of Town Brook, a mixed land-use sub-basin of the WBDR. Thus, three different scales, entire basin, sub-basin and farm-scale, are currently

being monitored for water quality using event-based sampling methods.

Groundwater Project

The DCAP Groundwater project was begun in November 2004. The objective is to test if groundwater paths can account for transport of dissolved phosphorus to the Cannonsville basin surface water. Recent basin simulation models suggested up to twenty percent might move via a slowly varying seasonal source.

Sampling for up to 18 months at seventeen wells, springs, or tile drains will be completed in July 2006.

Project leaders are WRI and the Delaware County Soil and Water Conservation District. Cooperators include the DEC, Town of Tompkins, Village of Walton, three farms, Cornell Biological and Environmental Engineering, and WAC.

Using Monitoring Results

DCAP takes advantage of and builds upon these monitoring activities in several ways. First, more informed management decisions will be made by utilizing the available water quality information to evaluate inter-annual variability in nonpoint source phosphorus loads, and assess relative contributions by sources in the Cannonsville watershed.

Secondly, DCAP is making use of the available water quality data as input to various models that can be used to estimate future loads to the reservoir under different management scenarios. The data are also crucial for calibrating and validating the models. Models that accurately stimulate measured loads under current conditions will then be selected and applied with confidence when predicting future conditions. The SWAT model has been successfully applied to the three watershed scales using data from the monitored sites in the WBDR basin and promises to be a useful tool for decision-making and planning in the future.

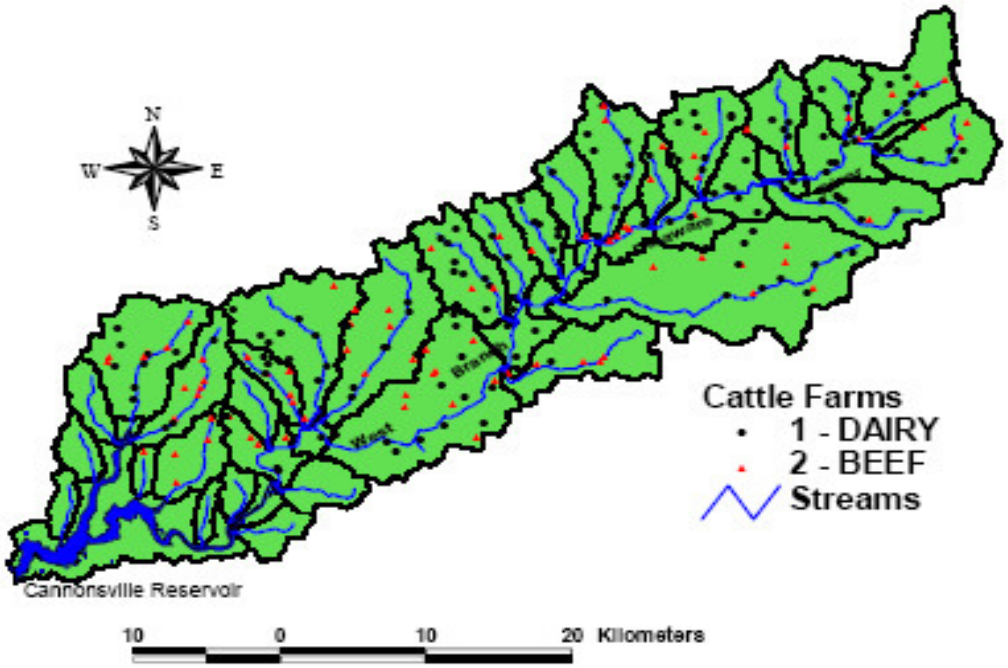
Despite an abundance of monitoring data currently being produced, more information is needed in certain areas to assist in making informed management decisions. Confirmation by monitoring and modeling of the ability of selected BMPs to significantly reduce phosphorus losses is one important need. This has been accomplished with the long-term monitoring at the upland farm. However, it must be determined if the results at this location are representative of other farms in the watershed. Information gathered at the lowland farm will help do this. If management programs are to be targeted at animal and human waste sources, there must be confidence that BMPs will work. Although Delaware County has been removed from the phosphorus restriction given its in-reservoir concentrations dropping below the 20 mg/L guidance value, continued monitoring of loads to the Cannonsville Reservoir are necessary to track progress and ensure point and nonpoint source management programs continue to have a positive effect. Water quality must not only be secured; it must be confirmed.

Coupled Assessment through Integrated Climate and Terrestrial Models

Weather patterns demonstrate it is prudent to assume future extreme patterns in weather will affect watershed hydrology. Through the Northeastern Regional Climate Center at Cornell, climatological patterns and available data will be used to integrate the climatological studies with a watershed model, Soil and Water Assessment Tool (SWAT). This will provide a comprehensive evaluation of existing hydrological conditions and future scenarios in the basin. Appropriate models have rarely been linked creating a fully comprehensive, basin wide analysis of the effect of climate and land use changes and their impacts on aquatic systems within the basin.

Linking Models

Climatological data linked with a terrestrial model enables the assessment of water management and land use decisions from a basin-wide perspective, incorporating ecological and economic values. Such assessments are needed to facilitate the ability of basin residents, planners and decision-makers to formulate reasonable water management, economic and social goals and policies.



Farms in the Cannonsville Reservoir Basin.

The integrated climatological and terrestrial modeling will:

- Describe and integrate knowledge of the system under current and historical conditions;
- Allow for the assessment of prospective future scenarios (i.e., climatological changes and land management options allowing for uncertainties); and
- Evaluate changes due to management or natural conditions within the river basin.

Training will be provided to watershed stakeholders in the use of the model.

Applying SWAT

Soil and Water Assessment Tool 2000 (SWAT2000) is a spatially distributed watershed model used to describe phosphorus transport to the Cannonsville Reservoir in Delaware County. SWAT2000 was developed by the Agricultural Research Service of the US Department of Agriculture and is distributed by the US Environmental Protection Agency. SWAT2000 simulates through time the daily soil water balance, growth of plants, buildup of nutrients in the soil due to agricultural management practices and subsequent erosion and transport of nutrients to streams and rivers. The soil nutrient mass balance in SWAT2000 results in temporally varying levels of soil nutrients due to either nutrient depletion or excessive nutrient application rates. The rate of phosphorus export from soils to rivers increases as soil phosphorus levels increase. The spatially distributed nature of SWAT2000 means that the processes are represented independently in different regions across the basin.

The overall goal of the application of SWAT2000 to the Cannonsville Reservoir Basin has three parts:

- Understanding the phosphorus budget, its inputs, outputs to watercourses, and storage within the watershed;
- Identifying and evaluating quantitatively the effects of management options on phosphorus loading to the Cannonsville Reservoir; and
- Assisting in evaluating the results of the adoption and implementation of management options in improving water quality in the Basin.

Simulation results from the model over the period 1990-2000 highlighted useful findings:

- Prediction that 68 percent of the total phosphorus loading into the surface waters originates from active agricultural lands;
- A major source of agricultural phosphorus loading was corn land (covered only 1.2 percent) of the watershed;
- Largest phosphorus loading rates per unit area were areas North and East of the Town of Delhi; and
- Non monitored areas immediately surrounding the Cannonsville Reservoir were simulated to have substantially lower non-point source phosphorus unit area loading rates than the monitored areas.

Conclusions

The current version of the SWAT2000 Cannonsville Basin Model has been calibrated and validated successfully. The model has been shown to reasonably represent the temporal and spatial nature of the measured flow and water quality data at multiple locations in the basin.

A number of important benefits to Delaware County stakeholders as well as other users of the general SWAT2000 model are the result of this comprehensive modeling effort. They are as follows:

- The SWAT2000 basin modeling approach provides the scientific framework for compiling and integrating the Delaware County Action Plan;
- Model phosphorus inputs are summarized in a way that is potentially useful to local decision-makers in the absence of a basin model and will help facilitate understanding and communication between all stakeholders;
- The basis for phosphorus input information is outlined in sufficient detail in a report for future modelers in the basin to repeat the input development when new input data become available or if a future model of the basin is developed; and
- The model could provide improved inputs to the more complex reservoir model currently being investigated by the NYC DEP.

Management and Stakeholder Involvement

Modeling is conducted in close cooperation with members of the interagency DCAP Scientific Support Group. Progress is reported regularly to the County's Phosphorus Study Committee, a representative body of principal stakeholders. A particular objective is to encourage a modeling capability in County and CWC staff.

Infrastructure

Sustainable and reliable solutions are continuously needed in support of the infrastructure of rural communities for highways and waste disposal systems. Therefore, local agencies in Delaware County work together to develop economically viable solutions for its infrastructure while maintaining the unique personalities of each community.

Three of DCAP's components to protect water quality and quantity from nonpoint source contamination are expanded in this section.

- On-Site Septic Systems and Wastewater Treatment Plants: Delaware County soils present problems for conventional systems;
- Roads, Highway and Solid Waste: Management practices are developing to minimize surface water contamination from County roads and highways; and
- Stormwater Management: Identifying deficiencies and assessing existing stormwater infrastructure are the first step in the development of efficient and effective localized management tools.

On-Site Septic System Program

The MOA's provisions for onsite wastewater systems do not deal directly with the impact of phosphorus loading from on-site septic systems. However, the MOA's program for improving these systems should aid in the effort to reduce phosphorus on a basin-wide scale. Old and/or failing septic systems can cause phosphorus leakage, and the MOA's Septic System Rehabilitation and Replacement Program will fund many repairs.

The Watershed Regulations call for stricter design, operation, treatment, and maintenance of all "subsurface sewage treatment systems." The following is a list of necessary conditions for a given system:

- All systems shall prevent the exposure of sewage to the surface or the discharge of sewage to groundwater;
- Mound systems, intermittent sand filters, and evapotranspiration/absorption systems are prohibited;
- An additional area of at least 100 percent of the primary absorption field area shall be set aside as a reserve absorption field area;
- Building fields under pavement or other impervious surfaces is prohibited, as is building pavement or other impervious surfaces over fields after installation;
- At least one percolation test and one deep hole test must be performed in each field area, and DEP must be informed and given the option of observing these tests;
- Proposed sites with soil percolation rates faster than three minutes per inch or slower than sixty minutes per inch shall not be approved; and
- When possible, gravity flow systems shall be used for subsurface sewage treatment systems; use of pumping, mechanical dosing, or other mechanical devices shall require a pump chamber, equipped with an alarm to indicate malfunction; and systems must have a backup storage tank or pump capable of holding one to two day's flow, depending on system size.

Additionally, the DEP provides for programs to improve septic systems on both a community and an individual basis. Though DEP is providing funding to the West of Hudson for implementation of these programs (see, "City's Costs due to MOA Obligations"), County Health Departments can request to oversee the process. According to the MOA, if any County in the Watershed has or establishes a Health Department with an NYS Depart-

ment of Health (DOH) certified program (or contracts with an existing local Health Department for such a program), the local Health Department may apply for delegation of DEP's authority. The local Health Department will then be responsible for reviewing and approving new subsurface sewage treatment systems in that County. If there is disagreement between a local Health Department and DEP about a particular subsurface sewage treatment system, either DOH or DEC shall act as a mediator; if the mediator cannot resolve the issue within 15 days, both the local Health Department and DEP shall retain their independent review and authority. Thus, counties in the Watershed have perhaps a greater chance for authority in the case of onsite wastewater systems than in either wastewater treatment plants or stormwater controls.

Delaware County Soils

Soils in Delaware County represent a challenge to farmers and engineers alike. The soils tend to be thin, overlying a highly impervious fragipan. Frequently the soils have a marked slope given the hilly topography of the County. Staff at the SWCD are leaders in soil and site evaluation for septic systems.

The SWCD's study of septic systems in the Cannonsville Reservoir Basin resulted in the creation of a database of on-site conditions using digital soil survey data. This database contains more than 1100 existing septic system siting records. Soil map units were grouped into four classes based on their suitability to meet common septic system design criteria. A geographic information system analysis indicated that while 80 percent of soils in the watershed were found to have characteristics that interfere with septic system function, 69 percent of septic systems installed were designed for soils with no or few restrictive parameters. The results of the study imply that many septic systems functioning in the watershed are in need of design improvements (Day, 2004).

SWCD staff estimate that the septic systems contribute from 2 – 4 percent of the total phosphorus load to the reservoir. This relatively small load understates the significance of septic systems however, given they are also a potential source of pathogens and other contaminants. The SWCD is working with the CWC to assist in the acquisition of funding for a septic system rehabilitation and maintenance program.

Wastewater Treatment Plants

DEC will revise SPDES permits for all existing Wastewater Treatment Plants (WWTPs) to reflect the phosphorus limits in the Watershed Regulations.

Initially, the Cannonsville Reservoir Basin was phosphorus restricted under the Watershed Rules and Regulations (WR&R). Expansion of WWTPs were severely limited. However, variance provisions allowed for limited expansion. This lead to the development of a comprehensive strategy as required by the WR&Rs for the expansion of WWTPs in phosphorus restricted basins and is implemented through DCAP. The upgrades to the Walton, Delhi, Hobart and Stamford WWTPs in combination of numerous nonpoint source reductions have since lead to the delisting of the Cannonsville Reservoir from the City's phosphorus restricted list. However, the Reservoir continues to

be eutrophic and is subject to Waste Load Allocations under the TMDL.

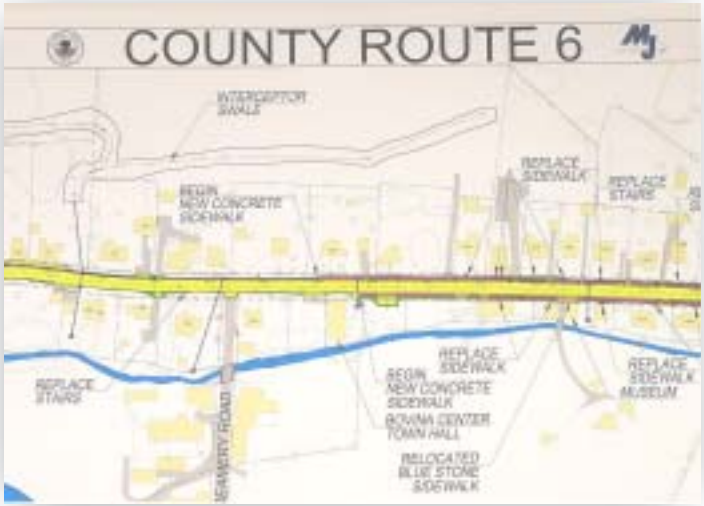
Roads, Highways and Solid Waste

Through its Department of Public Works (DPW), Delaware County, completed an assessment of highway stormwater impacts in 1999 and continues to maintain a comprehensive highway inventory and assessment program. This program has been recently expanded to fully document, using GIS methods, the location, maintenance, and management of roadway and stormwater infrastructure of the County. Under this program, all major drainage features such as culverts, swales, catch-basins, and bridges have been inventoried, mapped and assessed. Efforts to minimize negative water quality impacts include both capital construction projects and ongoing management practices.

Capital Construction Projects

These include:

- The County Route 6 stormwater system retrofit includes the installation of new catch basins and conveyance structures to manage stormwater adjacent to the Little Delaware River.



- Delaware County recently received a Water Resources Development Act grant to repair culverts with slip liners. The culverts identified for replacement are selected from an inventory of the County's Highway Management Plan by the Departments of Public Works and Planning. This project will reduce erosion and hence sediment and phosphorus delivery to the water supply. This project will address nearly 180 culverts that are in bad or poor condition.

- Modification and extension of stormwater conveyance and treatment structures along County Route 2 in Delancey. The Delancey County Route 2 retrofit will extend the existing the stormwater conveyance structures up to the County bridge over Bagley Brook, and includes modifications of the current stormwater system to accommodate catch basins with sediment and trash sumps, and access ways within the conveyance structures sufficient to allow for regular vacuum truck cleaning. The Delancey County Route 2 project is in proposal stage, pending acquisition of financial support.

Ongoing Management Practices

- *Sediment Removal:* with critical financial support of the Catskill Watershed Corporation, DPW purchased and put into service a vacuum truck capable of removing sediment from culverts and catch basins with a 30 foot pipe reach and 12 cubic yard sediment holding capacity. This truck is being used to removed sediment throughout the County and is eligible for use in neighboring Watershed counties on an "as-needed / as-available" basis. Approximately 1,200 cf of sediment was removed during the first three months of operation, with culvert cleaning activities typically occurring from April through November. The sediment removed from drainage systems is disposed of securely, thereby eliminating this contaminant source to the Cannonsville and Pepacton reservoirs. The County has begun sampling these sediments to quantify the amount of phosphorus and other contaminants removed. Should the County acquire a second

vacuum truck, the rate of sediment removal and culvert and catch basin maintenance would be performed on a 5-year rotating cycle. High priority and high sediment areas receive more frequent cleaning.

- *Culvert and Outfall Stabilization:* Extensive visual inspection conducted by the vacuum truck crew has identified culverts needing repair or replacement. Culvert failure is a source of water quality degrading sediment infiltration requiring stabilization to mitigate against these sediment inputs. Traditional culvert replacement requires physical excavation, replacement in kind, and backfillling of culverts; with a resulting soil surface disturbance and short term aggravated sediment during this procedure. The County now slip lines failed culverts wherever possible as a preferred method of culvert stabilization absent the sediment creation during traditional excavation. Where applicable, slip lining affords a fast, environmentally preferable and financially competitive method of repair. Culvert slip lining is performed concurrent with outfall stabilization to reduce potential scour from high energy culvert discharges.

- *Programmable Ice Control Systems:* implemented during the 2001-2002 winter season, DPW achieves improved control and limits on the application of road deicing materials through the installation of programmable controllers on snow plow truck spreaders. These low cost units, used for conveyor/spinner spreaders on grit and salt trucks, allow the truck operator to apply granular deicing material precisely. Excess is eliminated by synchronizing the application rate with truck speed. As the truck speeds up or slows down, the spreader rate automatically adjusts to match the truck speed. When the truck stops, the material application stops. Benefits from this management practice on county roads show a 15 percent reduction in the use of salt and deicing abrasives. Potential annual reductions are estimated for
  - Sediment — 3,600-4,964 tons
  - Salt — 1,800-2,480 tons
  - TP — 370-500 grams

Highway Management Plans for Towns

The County's 1999 highway assessment identified 60 percent of roads in the Cannonsville Basin as being Town roads. Therefore, to be comprehensive, highway stormwater efforts require including Town roads. DPW proposes to extend the highway management program (HMP) to Towns to address inventorying and assessment of Town roads, identification of priority stormwater management practices (SMPs), capacity building through the provision of expertise and training to Town Highway Superintendents for the SMP management practices and installations, and evaluation and monitoring of these SMPs. The first phase of the Highway Management Plan program includes the initial development of inventorying and assessment procedures, coupled with internal training and experience with SMP projects, as DPW is currently doing. To extend the Highway Management Plan to the Towns as a next phase will require hiring a dedicated stormwater / highway engineer responsible for providing the leadership and expertise to meet the demands of the program. A primary function of the highway engineer will be to assist towns with prioritizing their highway capital projects. Many of the areas identified as critical areas for redesign are being repeatedly damaged by

poor drainage; however many towns don't have a dedicated budget for Stormwater projects. The stormwater engineer will be responsible for accessing the funding available through the CWC Stormwater Retrofit Program and matching those funds with the annual regular capital planning in the town highway budgets. This will maximize the investment of the towns by targeting the areas most in need of redesign, repair and rebuilding, and will also maximize the CWC funds by allocating those funds to the most critical areas in regards to water quality.

To date, the county baseline inventory for HMPs is complete. As noted earlier, the 17 towns in the New York City Watershed are interested in conducting an inventory of their roads. Delaware County has received a grant to assist them in completing the inventory. In the Susquehanna River Basin, the Town of Davenport has completed their baseline inventory.

Solid Waste Division

DPW provides transportation and disposal services for municipal solid waste generated within Delaware County at its Solid Waste Management Center. Specifically, this includes ownership and operation of a double composite lined MSW landfill, a lined C&D landfill, recycling center and intermediate processing facility, and a fleet of transfer vehicles. In 2001, Delaware County began construction of a 128,000 square foot compost facility capable of processing all current and future wastewater treatment plant biosolids and municipal waste organic materials. Design and construction plans for this facility have been modified, at the County's sole effort, to accommodate 10,000 tons of agricultural manures. DPW began start-up operation in December 2005. The ability to stabilize nutrients and destroy pathogens in biosolids and manure will greatly assist in reducing the potential load of surplus phosphorus in the Cannonsville basin.

Operation CLEAN SWEEP: Annually for the past nine years, DPW has been the lead sponsor of a multi-agency effort to safely remove hazardous and semi-hazardous wastes from homes, farms, and small businesses throughout Delaware County and the NYC Watershed. With steady financial aid from DEC and NYC's Watershed Agriculture Council, and periodic support from USEPA, CWC, and SWCD, the County has accepted for proper disposal waste flammables, corrosive and oxidizing substances, pesticides and toxics, PCB wastes, batteries, CFCs, and hazardous electronic wastes. Through generous financial support, this service is provided at no cost to households and farms, and at a subsidized rate for small businesses. In 2002, CLEAN SWEEP serviced 282 participants, resulted in the proper disposal of over 81,000 pounds of wastes, at a cost of $66,000. An extremely valuable service, CLEAN SWEEP provides area residents with an environmentally sound alternative to dumping hazardous liquids down the drain, on the back

forty, or in the burn barrel. (Note: DEC funding comes from a long standing HHWCD grant program that is a substantial mainstay to these activities!)

Delaware County's eighth Clean Sweep was held October 1 and 2, 2004. Approximately 270 people participated in what was deemed one of the most successful by the county coordinator of solid waste management. Clean Sweep was a cooperative effort of the Delaware County Department of Public Works, Cooperative Extension of Delaware County, The Watershed Agricultural Council (WAC), and the Delaware County Industrial Development Agency. Funding was provided by the NYS Department of Environmental Conservation, the NYC Department of Environmental Protection, WAC, and Delaware County.

Research and Demonstration Projects:

Dissolved Phosphorus Removal in Stormwater:

DPW, with financial assistance from the USACOE, has sponsored research with the State University of New York College of Environmental Science and Forestry to evaluate the potential use of high iron content materials for the removal of dissolved phosphorus in stormwater. Use of chipped passenger tires as an iron source, and monitoring phosphorus laden stormwater under controlled laboratory conditions, research indicates a potential dissolved phosphorus removal rate upwards of 50 percent. A promising stormwater treatment advancement, continued research will focus on an expanded analysis of sustainability and life cycle of the DP removal process, ancillary water quality impacts from use of tire chips, and field based constructability.

Oxbow Hollow Wetlands Bank:

In an effort to increase wetland habitat and environs with the County, DPW has recently proposed construction of half an acre of palustrine wetland on County owned property adjacent to the Delaware River West Branch. The existing two acre Oxbow Hollow Wetland Bank contains many "obligate" and "facultative+" wetland species, including: pondweed, cattail, red top, water carpet, spearmint, watercress, soft rush, and jewel weed. Consultation and support is provided by the Soil and Water Conservation District and construction has been done with County staff. Up to twenty acres of new wetland creation is planned for the property and provides an important environmental enhancement and construction training ground for equipment operators and facility designers.

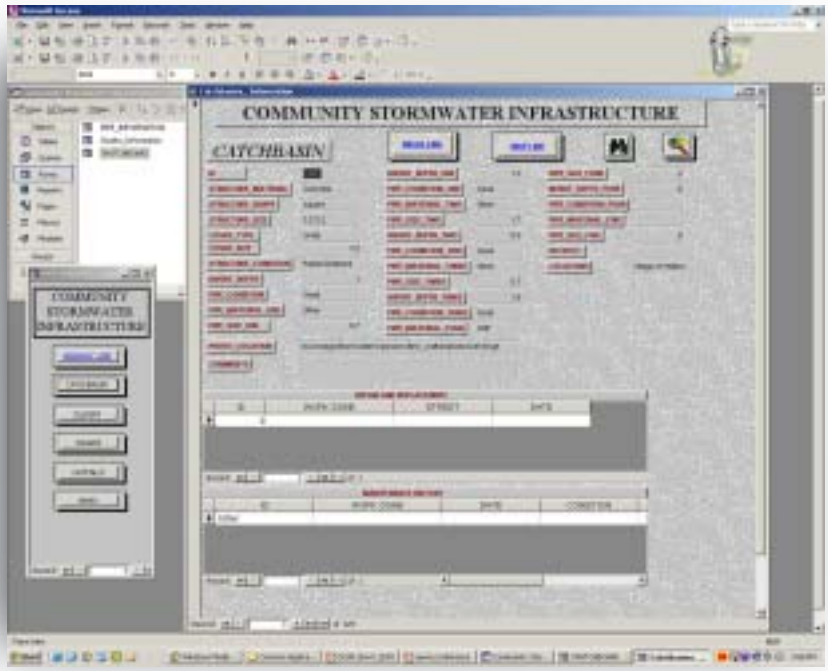
Municipal Stormwater Management

All basins in the Watershed must establish stormwater pollution prevention plans for certain activities.

The following list of activities requires stormwater pollution prevention plans in the West of Hudson region:

- Plans for the development or sale of land that will result in disturbance of five or more acres of total land area;
- Construction of a subdivision;
- Construction of a new industrial, municipal, commercial or multifamily residential project that will create an impervious surface totaling over 40,000 square feet;
- A land clearing or grading project of two or more acres, any portion of which is located either within 100 feet of a watercourse or wetland, within 300 feet of a reservoir, reservoir stem, or controlled lake, or on a slope exceeding 15 percent;
- Construction of a new solid waste management facility or modification of an existing one that is within 300 feet of a watercourse or wetland or within 500 feet of a reservoir, reservoir stem, or controlled lake;
- Construction of a gas station;
- Construction of an impervious surface for a new road;
- Construction of an impervious surface within a village, hamlet, village extension, or area zoned for commercial or industrial uses; and
- Up to a 25 percent expansion of an existing impervious surface at an existing commercial or industrial facility within 100 feet of a watercourse or wetland.

Stormwater Pollution Prevention plans for these activities must be prepared and implemented according to the requirements of the DEC SPDES General Permit for Stormwater Discharges from Construction Activity Permit GP-02-01. In phosphorus restricted basins, plans must include the necessary phosphorus components.



In terms of administration, the City has established Stormwater Project Review Committees in order to assist DEP in the implementation of the prevention plans. Towns and Villages may designate one representative each to the committee, within fifteen days of the MOA's effective date. This Committee can make recommendations to DEP concerning applications for the above-listed activities, but DEP makes the final decision on approval.

At this writing the City of New York is proposing changes to the WR&Rs. Currently, and perhaps continuing into the future, a project applicant has to comply with both the City's stormwater permit and the State's Phase II stormwater permit. This creates confusion as well as additional costs for project applicants, raises questions concerning what is eligible for payment by the CWC, and creates an additional burden to reach compliance for both permits. The goal should be to streamline and eliminate the dual permit requirement in the near future.

Objectives

A significant source of water quality impairment is urban stormwater runoff. Stormwater discharges are generated by runoff from land and impervious areas such as paved streets, parking lots, and building rooftops during rainfall and snowmelt events. This runoff accumulates pollutants such as petroleum hydrocarbons, pesticides, nutrients, metals, and pathogens as it travels across the land in quantities that can adversely affect water quality. For example, it is estimated that stormwater runoff contributes an average of approximately 3200 kg/year or six percent of the entire phosphorus loading to the Cannonsville Reservoir.

To address stormwater runoff in Delaware County, the Planning Department, working in conjunction with the DPW, has developed the following long-term management programs.

1. *Inventory, Assessment, and Evaluation of Stormwater Sources and Infrastructure*

The goal is to identify all point and nonpoint sources of stormwater in the village and hamlet areas that may pose a threat to water quality and manage them to reduce their impact on water quality. To this end, the Department will locate and assess existing stormwater infrastructure; develop, implement and monitor stormwater Best Management Practices (BMPs); and evaluate problem areas and recommend solutions.

Work Completed

- A detailed evaluation of stormwater sources (business roofs, parking lots, and other large impervious surfaces) and conveyances systems was completed in the Villages of the Cannonsville Basin. Locations and characteristics of these areas were field collected using GPS and

layered with other potential fields of interest including soils, land use, and topographic and planemetric maps. Preliminary estimates of sub-basin runoff and pollutant loadings were also calculated.

- A GIS database was created to enable characterization and cross-reference of the stormwater sources with the location of existing municipal stormwater infrastructure in the Cannonsville, Pepacton, Upper Delaware, and Upper Susquehanna watersheds.
- With the help of engineering consultants, stormwater collection, conveyance and treatment methods were implemented in the villages of Delhi, Stamford and Walton.

Next Steps

- Expand the GIS database to include stormwater sources and existing municipal stormwater infrastructure in municipalities of the upper Susquehanna watershed.
- Assess and monitor the effectiveness of stormwater treatment units in the Village of Walton and the Vactruck.
- GPS stormwater outfalls throughout the Cannonsville Basin in order to complete the GIS database for hamlet and village stormwater infrastructure.
- GPS stormwater outfalls in the Pepacton, Upper Delaware, and Upper Susquehanna watersheds.

2. *Local Implementation and Municipal Plan Development*

This task entails working with each municipality, under the auspices of the Town Planning Advisory Service (TPAS), to develop local initiative regarding water quality protection through stormwater management and to demonstrate the role of water quality in relation to community economic development. Each municipal strategy will analyze and incorporate previous work to develop a prioritized plan to meet current and future needs for repair, expansion, and management of local stormwater infrastructure. Maintenance programs will also be developed to continually assess the condition of the stormwater system, to track sediment by volume and type removed, and to reduce the likelihood of flooding due to clogged collection and conveyance systems.

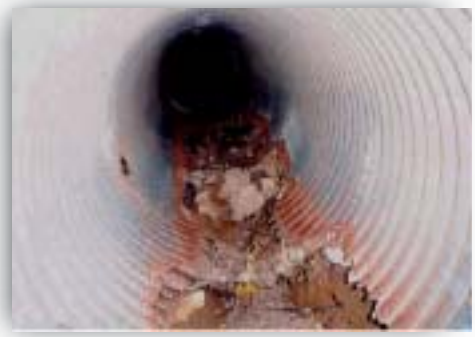
- Stormwater Management Plans (SMPs) will be developed that are consistent with Section 18-81 of the Watershed Regulations and Phase II EPA Stormwater Regulations. These plans will incorporate stormwater considerations into local capital planning and infrastructure management. Based upon the infrastructure inventories and SMPs, each municipality will develop a specific stormwater ordinance to address its future stormwater management requirements.

Work Completed

- Comprehensive Source Water Protection Studies for the Villages of Margaretville and Fleischmanns to safeguard each municipality's wells and springs.
- A comprehensive wellhead protection study for the Village of Margaretville to establish protective overlay zones for the municipality's wells and springs.
- A pilot stormwater management plan for the Village of Waton.
- The Planning Department and a consultant are finalizing the pilot SMP for the Village of Walton.

Next Steps

- Comprehensive wellhead protection studies for the Village of Fleischmanns and the hamlet of Roxbury.
- Continue comprehensive outreach and education for municipalities and their residents of the impacts of polluted stormwater on water quality.
- Begin implementation of protective measures for the wells and springs of Margaretville and Fleischmanns as identified in their Source Water Assessment Studies.



Legal and Administrative Framework

Purpose and Context

Inter-municipal and interstate water agreements entirely encompass Delaware County. On June 11th, 1953, New York State enacted the first watershed rules and regulations for the Department of Water Supply, Gas and Electricity of the City of New York. In 1961 the States of Delaware, New Jersey and New York and the Commonwealth of Pennsylvania, and the United States of America agreed and covenanted to create the Delaware River Basin Compact. Nine years later, the States of New York and Maryland and the Commonwealth of Pennsylvania, and the United States similarly covenanted and agreed to the Susquehanna River Basin Compact thus bringing the whole of Delaware county under some form of water jurisdiction. From federal statutes, interstate and inter-municipal agreements to local Home Rule prerogatives, there is a complex framework of statutes and regulations governing DCAP. Each successive layer of legislation introduces new terms and concepts, the result of which is an intricate and often confusing legal framework. This section elucidates relevant legal obligations regarding water resources in Delaware County. There are two basic premises:

1. Municipal Comprehensive Planning is a locally effective instrument to promote land use measures to protect water quality and quantity; and
2. Such planning under home rule prerogatives can be assimilated with implementation of state and federal laws to best ensure their water resource goals are met through cooperative partnership.

Home Rule

It is a basic premise of DCAP that the local capacities of Delaware County are best suited to meeting the water quality and economic goals of the New York City Watershed. This premise reflects Home Rule convictions. Home Rule authorities in New York have Constitutional and Statutory Sources. The Constitution of New York State grants local governments substantial autonomy and prerogatives. Article IX of the constitution, adopted by amendment by vote of the people November 5, 1963, is a Bill of Rights for local governments. The Article empowers local governments to have an elected legislative body, to enact local laws and to incur and apportion costs of local services. Section §2 (3) (c) (6) confers to local governments powers to adopt and amend local laws regarding the "acquisition, care, management and use of its highways, roads, streets, avenues and property". Section §2 (3) (c) (10) also charges local government with protection, order, conduct, safety, health and well being of persons or property within its jurisdiction. In addition, the New York State Legislature has enacted a very substantial body of statutory law conferring a very wide array of substantive and procedural powers to local government. In particular Home Rule powers derive from General Municipal Law, County Law, Town Law, Village Law and Highway Law.

General Municipal and County Authority

Delaware County has a strong infrastructure to manage its environmental interests. In 1945, the County Board of Supervisors created the Delaware County Soil Conservation District (Soil Conservation Law, Chapter 883, Laws of 1945). Recognizing the critical role of the District in managing nonpoint sources, on 24th February 1989, the Delaware County Board of Supervisors formally designated the Delaware County Soil and Water Conservation District "as the county planning, management and implementation agency for all nonpoint source water quality programs" (Resolution No. 42).

Broader planning functions for the County were formally established by the Board of Supervisors in 1966 in its creation of a Planning Board pursuant to Article 12B of the General Municipal Law of the State of New York.

Towns located within Delaware County have set up their own regulations regarding land use planning and the environment. These regulations are meant to work in conjunction with existing state and federal law. Delaware County has already assumed responsibility for its own environmental health and safety. For example, the town of Franklin has various subdivision regulations, which take the environment into consideration. The Planning Board of the Town is authorized to review and approve plats for the subdivision of land. For such subdivisions, the Planning Board requires proper provision for surface drainage, water supply, sewage, and other needed improvements. If there are violations or a lack of compliance, the Board can bring its findings to the Town Attorney. Furthermore, the Planning Board is authorized to determine the applicability of SEQRA (State Environmental Quality Review Act). If a subdivision is classified as Type I or Unlisted under SEQRA, the applicant must complete an Environmental Assessment Form. Finally, Article 510 of Franklin's subdivision regulations note various environmental considerations for applicants. According to Article 510, natural features of an area must be preserved. This requirement includes preserving all worthwhile trees and shrubs on the site as well as disturbing the soil as little as possible. Land subject to serious or regular flooding shall not be subdivided in such a way that would aggravate the flood hazard. In terms of sediment control, the applicant can expose only the smallest practical area of land at any one time during the development, and he or she must install basins to remove sediment from runoff waters. These are only a sample of the provisions that Franklin's subdivision regulations make for environmental protection.

In addition, Franklin's zoning ordinances consider environmental impacts. Two of the central purposes of the zoning ordinance are to protect the open and natural character of the land and to promote the health, safety, and general welfare of the public. No land use or structure can be established nor land developed until a permit has been issued by the Zoning Enforcement Officer. Where relevant, applications must show evidence that application for a Sewage Disposal Permit from New York City DEP has been made. No building permit shall be issued for any proposed building or land use which, in the judgment of the Zoning Enforcement Officer, would require an environmental assessment in accordance with the State Environmental Quality Review Act of 1975 and any County or Town regulations enacted pursuant thereto; such an application shall be referred to the appropriate land agency for a determination as to whether an environmental impact assessment will be required. Thus, the zoning ordinances in Franklin mandate a certain amount of environmental protection.

The Tables on pages 14 and 15 are a sample of land use planning laws in Delaware County. The tables are intended to give a general idea of the degree of responsibility that county authorities have assumed to manage their local environment.

Federal Framework

Congress enacted the federal Clean Water Act (CWA) in the mid-70s, with a goal of reducing pollution so every water body would be safe for both fishing and swimming. The CWA created a framework consisting of Water Quality Standards, NPDES permits, and TMDLs to guide the states towards this national goal.

The federal Safe Drinking Water Act of 1974 (SDWA) was passed to protect drinking water across the nation. In 1987, subsequent amendments to the SDWA included the Surface Water Treatment Rule (SWTR), which is pivotal importance for DCAP. The SWTR requires all surface drinking water sources to be filtered, unless the EPA has otherwise

determined that requisite watershed conditions are met.

In order to ensure that New York City could continue to meet these SDWA watershed conditions, NYC, NYS, the EPA, local governments and environmental organizations entered into the New York City Watershed Memorandum of Agreement (MOA). Although this is largely in response to the SDWA's requirements, the MOA contains much of the same structure and language as the CWA (such as the use of TMDLs).

The Clean Water Act:
The National Framework

The Clean Water Act—from the 1972 Federal Water Pollution Control Act to its 1977 and 1987 amendments—was a response to the growing national concern for the quality of America's waterways. The CWA set a national goal for all waters to be "fishable and swimmable" and provided a national framework consisting of Water Quality Standards, NPDES permits, and TMDLs.

1. *Water Quality Standards*

The chief mechanism of the CWA is the Water Quality Standard (WQS), which consists of the following three components:

a. Designated Uses: a description of the desired uses of a particular water body, such as recreation or fishing;

b. Numeric Water Quality Criteria: the in-stream conditions necessary to protect the designated use, i.e., physical or chemical characteristics such as temperature, minimum concentration of dissolved oxygen, and the maximum concentrations of toxic pollutant; and

c. Narrative Water Quality Criteria: a general statement that prohibits pollutants at objectionable levels, such as the narrative criteria of "no toxics in toxic amounts."

Guidance Values. For many pollutants that do not have a Water Quality Standard based on Numerical Criteria—such as phosphorus—the DEC determines a "Guidance Value". Both Water Quality Standards and Guidance Values are determined by scientific procedures described in 6 NYCRR Part 702. The difference between the two is that Guidance Values do not go through the same regulatory process as a WQS (i.e., the same level of public participation), and thus are not applicable to Clean Water Act legislation. Guidance Values are listed in the New York State Department of Environmental Conservation Technical and Operational Guidance Series (TOGS) 1.1.1. As we shall see, Guidance Values are given a significant role in the MOA.

2. *The National Pollutant Discharge Elimination System (NPDES)*

The Clean Water Act also establishes the National Pollutant Discharge Elimination System (NPDES), which requires all discharges from any point source into waters of the United States to obtain an NPDES permit. NPDES permits contain discharge limits, as well as monitoring and reporting requirements. Discharge limits are based upon:

a. Local Water Quality Standards: discharges may not contain pollutant or other characteristics in a level which would cause the receiving water body to fail its WQS; and

b. National "technology-based standards", which describe discharge limits by the discharge type, regardless of the local situation.

"In short, water quality-based standards are designed to protect specific water bodies, and tech-

nology-based standards are designed to assure a minimum level of control for a particular class of discharge, no matter where that discharge takes place."

Most states, including New York, have taken over the NPDES program, renamed SPDES (for State Pollutant Discharge Elimination System)

3. *The Total Maximum Daily Load (TMDL) Process*
   A TMDL is the maximum amount of a particular pollutant in a water body without the water body failing to meet a related water quality standard. The TMDL represents a theoretical threshold point, above which the amount of the pollutant being added cannot be assimilated by the water body without causing pollution. "TMDL" is a misnomer. Although the "D" stands for "Daily", since monitoring the daily load is highly impractical, TMDLs are often based on a seasonal or annual basis.

Section 303(d) of the CWA establishes the TMDL process. Each state must develop a list of all water bodies that fail to comply with the water quality standards corresponding to their designated uses. That list must then be prioritized, and a TMDL for each offending pollutant must be developed in each listed water bodies.

TMDLs are developed using local scientific data, with the aid of computer models and GIS. Also, TMDLs consider seasonal variations background pollution levels and non-point sources, plus a margin for safety. Although meeting a TMDL may require pollution controls, there are no specified procedures to institute those controls. DCAP has formulated procedures to meet the TMDL for phosphorus in the Cannonsville Reservoir that may serve as a blueprint for other water bodies.

Section 303(e) Required Continuous Planning Process

Section 303(e) of the Clean Water Act requires that every state shall have a continuing planning process (CPP) consistent with the Act. The section further stipulates elements that should be included in the CPP. Three of these elements, (3), (4) and (5) are of primary importance for DCAP (40 CFR Ch 1 §130.5).

> §(3) The process for developing total maximum daily loads (TMDLs) and individual water quality based effluent limitations for pollutants in accordance with section 303(d) of the Act and §130.7(a) of this regulation (40 CFR Ch 1).
>
> §(4) The process for updating and maintaining Water Quality Management (WM) plans, including schedules for revision.
>
> §(5) The process for assuring adequate authority for intergovernmental cooperation in the implementation of the State WQM program.

These and the other 9 elements specified in 40 CFR Ch 1 §130.5, are requirements and responsibilities of the state. However, within that state mandate, DCAP constitutes a local Water Quality Management plan with component processes to: Meet pollutant limitations, update and maintain the plan, and assure adequate local authorities to implement the plan especially through intergovernmental cooperation. Delaware County is currently exploring with the NYS DEC the option of acceptance of responsibility for components four and five.

The Safe Drinking Water Act

The New York City Watershed Memorandum of Agreement: The New York City Watershed Memorandum of Agreement (MOA) is a landmark arrangement between New York City, New York State, the EPA, local municipalities and environmental organizations, signed January 21, 1997. The goal of the MOA is for NYC to remain eligible for SWTR filtration avoidance through watershed management, without endangering the economic welfare of Watershed communities. The MOA creates both contractual and regulatory obligations for the various parties.

1. *Watershed Rules and Regulations*

According to Section 1100 of NYS Public Health Law, the NYS Department of Health (DOH) "may make rules and regulations for the protection of any or all public supplies of potable waters and water supplies of the state". Furthermore, the New York City commissioner of environmental protection "may make [similar] rules and regulations subject to the approval of the department [DOH] for the protection from contamination" of NYC's water supply. The statute outlines NY State and NY City's roles in inspecting watersheds as well as identifying and punishing regulation violators.

Attachment "W" of the MOA contains proposed Watershed Rules and Regulations for the NYC watershed that were subsequently approved by the DOH commissioner shortly after the MOA was signed. Referred to as Watershed Regulations in the MOA, they describe how the standard of quality for water bodies within the watershed shall be determined, list which watershed activities are subject to regulation and outline the requirements for obtaining pollution permits.

a. Standards of quality

The Watershed Regulations state, "the water in all reservoirs...shall meet the following standards of quality":

(1) New York State's Clean Water Act "Water Quality Standards" (As listed in NYCRR Parts 701 and 703)

(2) New York State "Guidance Values" (As listed in the DEC Technical and Operational Guidance Series (TOGS) 1.1.1.)

Additionally, the DEP must annually perform a review of all reservoirs to determine whether they meet or fail these standards of quality as defined above. Note that the Watershed Regulations will often refer to the standards defined in parts (1) and (2) as "water quality standards". This can be confusing since part (1) itself, 6 NYCRR Parts 701 and 703, comprise the State's Clean Water Act "Water Quality Standards". "Guidance Values" and "Water Quality Standards" have distinct roles in the federal and state Clean Water Act regulatory framework, even though the Watershed Regulations give them equal footing.

Importantly, the Watershed Regulations defines a phosphorus-restricted basin as "the drainage basin of a reservoir... in which the phosphorus load to the reservoir... results in the phosphorus water quality values [set forth in the DEC's TOGS 1.1.1] being exceeded as determined by the [DEP] pursuant to its annual review." (Subchapter A, subsection 18-16, paragraph 78.) At the time of signing the MoA, the DEP determined that the Cannonsville Reservoir was above the Guidance Value of 20 ìg/L since 2000, the Cannonsville Reservoir Basin is no longer a phosphorus-restricted basin.

b. Regulations

The Watershed Regulations regulate various activities within the Watershed; furthermore, these regulations can change when a particular basin, such as the Cannonsville Reservoir basin, is classified as phosphorus-restricted. Important regulations for DCAP are on-site and central wastewater treatment and stormwater. These topics are discussed in later sections.

2. *MOA and the Total Maximum Daily Load Process*

The MOA also describes how the Federal Clean Water Act section 303(d) TMDLs are to be applied for the New York City Watershed Water Supply. The DEP and DEC "will jointly develop Total Maximum Daily Loads ("TMDLs"), waste load allocation ("WLAs") and load allocations ("LAs") for phosphorus in each of the reservoirs in the Catskill, Delaware, and Croton Systems. The USEPA will provide technical support in the development of TMDLs and review and approve submitted TMDLs. The New York State guidance value [from TOGS 1.1.1]

will be used for TMDL development" (Article VI, paragraph 162).

- Since there is neither a national nor a state quantitative Water Quality Standard for phosphorus, the parties agreed to use the state's quantitative Guidance Value for TMDL development. However, because the current phosphorus Guidance Value of 20 µg/L is based upon aesthetic and recreational criteria, the EPA's TMDL Phase I decision letter required the DEC to reevaluate the appropriateness of the 20 µg/L Guidance Value for a public drinking water supply. In March of 1999, the DEP issued a report proposing a Guidance Value of 15 µg/L for the NYC Watershed reservoirs that are "capable of receiving surface runoff, and are located just prior to initial disinfection." This higher standard has now been adopted for the Pepacton Reservoir (How and When?).

- The TMDL process set forth in the MOA does not supercede section 303 (d) of the Clean Water Act. Rather, it describes the parties' understanding of how that process will be completed. Parties to the MOA agree not to challenge the TMDL process, provided it follows the description provided in the MOA. However, an outside organization, the Natural Resources Defense Council, has filed suit against the EPA, DEC and DEP for using the Guidance Value as the basis of TMDL development. They assert that because the Clean Water Act specifically calls for Water Quality Standards to be used in TMDL development, the use of any other value—such as a Guidance Value—is a violation of federal law.

The MOA described a loose schedule for TMDL development and refinement. At the time of the MOA's signing, the DEP had already developed "Phase I" TMDL reports, using the Reckhow method. Upon reviewing the Phase I TMDL reports, the DEC would submit them to the EPA for approval. Once approved, the DEP and DEC had a limited amount of time to evaluate and identify management practices for controlling nonpoint phosphorus sources. Furthermore, for every reservoir that exceeded its Phase I TMDL:

1) NYSDEC will propose permit modifications for surface water permits to implement the effluent limits for phosphorus specified in the Watershed Regulations;

2) Surface discharge WWTP permits shall require a total phosphorus effluent limit of 0.2 mg/l. Also, for new surface discharges, it is required that every one (1) kilogram of projected increase of phosphorus load be offset by a reduction of three (3) kilograms; for expanding an existing surface discharge, every one (1) kilogram of increased phosphorus load be offset by a reduction of two (2) kilograms. If the DEC determines that inadequately treated sewage is being discharged to the water supply, and the only remedy is a new or expanded WWTP, no offsets shall be required; and

3) Sub-surface discharge WWTP permits shall meet the following limits:

SPDES Permitted Total Flow (gal/day)	Total Phosphorus Limit (mg/L)
50,000	1.0
>50,000 and< 500,000	0.5
500,000	0.2

According to the MOA, Phase II TMDLs for the West of Hudson reservoirs will utilize a "generalized watershed loading function" model.

If a reservoir violates its Phase II TMDLs, the same stipulations listed above for violating the Phase I TMDLs will apply.

After Phase II, the DEC and DEP will continue to monitor and regularly assess the phosphorus load allocations for each reservoir basin, adjusting when necessary.

"The [DEC's] development of TMDLs for phosphorus shall not affect the City's agreement to pay the incremental costs, including operation and maintenance costs, to upgrade existing WWTPs to

comply with the phosphorus control requirements of the Watershed Regulations as [agreed to previously in the MOA].” (MOA, para. 162, (j))

A critical unresolved question arises when a water body, such as the Cannonsville improves in quality with the (phosphorus) loading falling below the TMDL specified threshold. To what extent are the regulations triggered by the TMDL adjusted in recognition of this improvement?

The Susquehanna River Basin

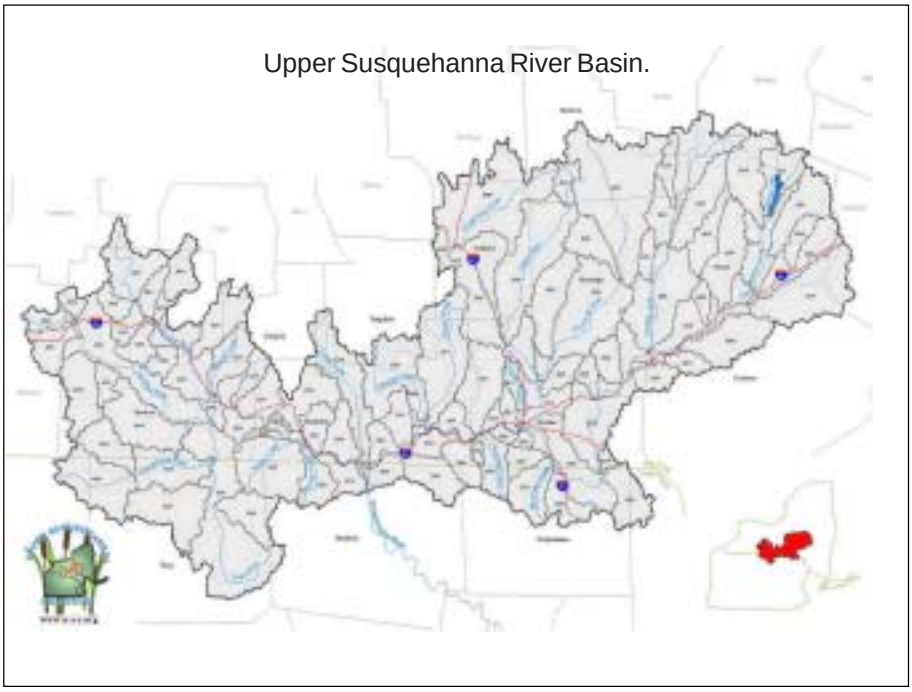
On June 28, 2000, the Chesapeake Executive Council signed Chesapeake 2000 a new multi-state agreement to guide combined efforts to restore and protect the Chesapeake Bay. For the first time, Delaware, New York and West Virginia are now formally partnered with EPA, the Bay states and the District to improve water quality throughout the entire watershed including the headwaters. To accomplish this goal, the state partners, including New York State agreed to reduce nutrient and sediment loads. This agreement incorporates the elements of the regulatory TMDL process, such as criteria, standards and load allocations.

Under the Chesapeake 2000 Agreement, the Cap Load Allocations, per year, for New York State are: 12.58 million lbs of nitrogen; 590,000 lbs of phosphorus; and 131 million tons of sediment. According to EPA, the actual loads in 2001 from the Susquehanna River in New York were: 19,100,000 million lbs of nitrogen, 970,000 million lbs of phosphorus, and 590,000 lbs of sediment. The cap allocations therefore mean reductions of more than a third for both nitrogen and phosphorus.

- Achieving these reductions in New York State, including Delaware County will primarily fall on landowners and farmers.
- The costs of achieving the reductions in New York State have not been estimated.
- Estimated costs for Maryland, Pennsylvania, and Virginia are respectively: $6.4, $6.2, and $6.1 billion with a combined total of $18.7 billion.
- As a very rough estimate, assuming proportionality based on nitrogen, the cost for New York could be of the order of $1.5 billion.
- It may be noted that the Susquehanna River in New York State, and specifically in the Charlotte and Oleout sub–basins in Delaware County, is already of good quality, which indicates the costs of improved water quality further would be high.

Under the Chesapeake Bay 2000 Agreement, tributary strategies will be developed to achieve and maintain the allocated nutrient and sediment pollutant loading caps in each basin. The strategies will be developed in each jurisdiction with extensive local government and public involvement”. This latter requirement raises the following questions:

- How are the reductions in loadings required by the Caps allocated to New York State to be technically achieved?



- What would be the technical options to achieve the reductions?
- What procedures would be followed to allocate the reductions among and within the tributary sub-basins ion New York State (I.e., what reductions would be expected in Delaware County?
- What would be the costs and how are they to be met?

It is critical to note that on March 16th this year, the EPA Chesapeake Bay Program Office admitted its Chesapeake Bay Watershed program will fail. This failure means that the CAP loadings will almost inevitably become TMDLs with associated regulations in 2010 or soon thereafter.

The Lower Delaware River Basin

The Delaware River Basin falls under the Basin compact under the jurisdiction of the Delaware River Basin Commission. Principle issues outside the New York City Watershed downstream of the Cannonsville and Pepacton dams are maintaining adequate flows of water of desired quality.

Creation of the Delaware County Department of Watershed Affairs

Section 18-83 of the Watershed Rules and Regulations requires the creation of a Comprehensive Strategy in phosphorus-restricted basins. In March of 1998, the Delaware County Board of Supervisors invited the NYS WRI to assist the County in creating this strategy. With the encouragement of the Board Chairman, Ray Christensen, WRI undertook a comprehensive review of the issues and possible options for the County.

In 1999, WRI with the County Planning Department submitted to the Board a draft strategy termed the Delaware County Action Plan (DCAP) The Board approved this DCAP in September 1999. To coordinate agencies and partners involved, the Board further established the Delaware County Department of Watershed Affairs (Resolution No. 229, pursuant to the authority granted by Section 204 of the County Law).

DCAP is a local municipal comprehensive plan. The development and application of DCAP has clearly demonstrated the desirability for the Clean Water and Safe Drinking Water Acts to recognize such local comprehensive plans where the plans well serve provisions of the Acts. Examples are the Wellhead and Source Water Protection Provisions of the Safe Drinking Water Act, §300h-7 and 300j-13, and the implementation of TMDLs through Clean Water Act § 303.

DCAP's Future Goals

Legal and Administrative Framework

- Goal 1: The role and standing of watershed communities in general, and DCAP as a Local Initiatives Program in particular, be provided more formal recognition and standing as the local partners in the state and federal legal framework governing the New York City watershed. This recognition is especially important in the FAD determinations and in application of the Clean Water Act § 303.
- Goal 2: Seek explicit acknowledgment of the role of municipal comprehensive planning, as the first protector and manager for water resources at the local land use level, in the applicable state and federal laws.

Economic Vitality

- Goal 1: Find support for and undertake an economic study of the economic impacts of the MOA: Specifically the Watershed Rules and Regulations, the land acquisition and easement programs, and the economic environmental partnership programs
- Goal 2: Re-examine and re-affirm the Delaware County economic development strategy particularly emphasizing its traditional industries including especially tourism and farming and to thereby continue to encourage traditional economic and industrial development in the County outside the NYC Watershed.
- Goal 3: Pursue environmentally compatible initiatives in NYC Watershed communities and businesses

Planning Tools for Water Quality Management

- Goal 1: Update and maintain the Delaware County Comprehensive Plan by explicitly incorporating DCAP objectives and procedures, in cooperation with the municipalities in the County.
- Goal 2: Continue to provide technical and planning support to County municipalities through the Town Planning Advisory Service (TPAS).
- Goal 3: Build upon the wellhead protection program to assist the public water supplies in Delaware County in developing a water supply protection plan.
- Goal 4: Integrate County Emergency Management and Hazard Mitigation Plans with the City's plans to ensure more effective and coordinated response by all parties.

Monitoring and Modeling

- Goal 1: Strengthen the modeling capability to represent the Cannonsville Reservoir basin at different geographic scales as required by management decisions and evaluation by integration of appropriate models including coupling SWAT to the Cannonsville Reservoir model.
- Goal 2: Improve and sustain the capability of County staff to use appropriate models for County management and evaluation purposes.
- Goal 3: Develop and use best understanding of climatological patterns and extremes to assist in better specifying management practices influenced by weather and in assisting in planning for, and management of, droughts and floods.
- Goal 4: Create and strengthen legal, administrative and social methods which recognize and advance home rule principles and which recognize the rights and responsibilities of landowners, businesses and residents in the County in serving and uniting environmental and economic objectives.

Infrastructure

- Goal 1: Upgrade (80%?) of the on-site wastewater systems identified as in need of upgrading by 2010.
- Goal 2: Carry out a comprehensive highway stormwater program throughout the County: Inventory and assess procedures; hire a dedicated stormwater/highway engineer to provide technical assistance and leadership; identify and remedy critical drainage areas; complete and institute Highway Management Plans throughout the County.
- Goal 3: Establish the capacity in the Department of Public Works to assist in the development of stormwater pollution plans for the activities that require such plans.
- Goal 4: Establish a local stormwater position to assist project applications through the permitting and implementation process.
- Goal 5: Ensure that City owned WWTPs can accommodate the growing need to receive septage from residential or sewer district pump-outs.

Agricultural Environmental Management

- Goal 1: Further develop and refine the Precision Feed Management planning process and define the criteria for implementing and accounting PFM as a Best Management Process under the NYS AEM program.
- Goal 2: Implement PFM planning on 50 farms in Delaware County by 2010.
- Goals 3: Foster the use of Critical Control Point analyses on those 50 farms.
- Goal 4: Establish a sound epidemiological and scientific foundation for managing pathogens on farms in Delaware County, identify best management practices and promote their adoption.

Stream Corridor Management

Stewardship of the Delaware River and its Tributaries and Associated Riparian Corridors

- Goal 1: Integrate the Watershed Agricultural Program and the Stream Corridor Management Program
- Goal 2: Expand technical support to the Conservation Reserve Enhancement Program (CREP) and enhance cropland CREP.
- Goal 3: Implement a variable width buffer pilot program.
- Goal 4: Participate with the Catskill Watershed Corporation to explore the enhancement of existing CWC programs and the development of new CWC funding.
- Goal 5: Seek funds to provide site specific plans for non-agricultural riparian landowner stewardship.
- Goal 6: Review stream gravel issues.
- Goal 7: Enhance existing permitting authority to the SWCD for implementation of approved stream management practices under its current General Permit.
- Goal 8: Assist municipalities with culvert sizing and design.
- Goal 9: Work closely with all DCAP participants to integrate the Stream Corridor Management Plan and its recommendations into all relevant components of DCAP.
- Goal 10: Expand public education and outreach efforts.
- Goal 11: Conduct geomorphic assessments at bridges and culverts.
- Goal 12: Establish a flood mitigation and recovery program throughout Delaware County.
- Goal 13: Continue geomorphic research and assessments
- Goal 14: Obtain sufficient funds to complete the Walton stream bank stabilization projects.
- Goal 16: Prioritize identified stream intervention projects
- Goal 16: Update the West Branch Delaware River Stream Corridor Management Plan.

Outreach

- Goal 1: Extend and apply the understanding largely developed for the Cannonsville Reservoir Basin throughout Delaware County.
- Goal 2: Through an inter-active informational program, promote the understanding, input and

engagement of businesses and residents in the County in DCAP activities, and to thereby secure sustainable management of the County's water resources in local, regional, state and federal contexts.

- Goal 3: Develop an effective institutionally-supported outreach plan with state and local watershed partners, to thereby extend the benefits of DCAP elsewhere in New York State and beyond as interests and means arise.
- Goal 4: Establish demonstration and education pilot programs to illustrate the relationship of HMPs, stormwater management and stream corridor management.

Evaluation

- Goal 1: Institute an external review of DCAP (Expert Panel?)
- Goal 2: Prepare a report annually for DCAP, which critically assesses the water quality conditions; evaluates management measures undertaken, and critically evaluates the achievement of stated goals. The report will be distributed for review and input by DCAP partners and constituents.