Natural Resource Management Plan

For the

Wappinger Creek Watershed

Prepared by the:

Dutchess County Environmental Management Council
Dutchess County Soil and Water Conservation District
Wappinger Creek Watershed Planning Committee
Dutchess County Water Quality Strategy Committee

With assistance from:

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Institute of Ecosystem Studies
Dutchess County Department of Health
Mid-Hudson Chapter of Trout Unlimited
Cornell Cooperative Extension Dutchess County
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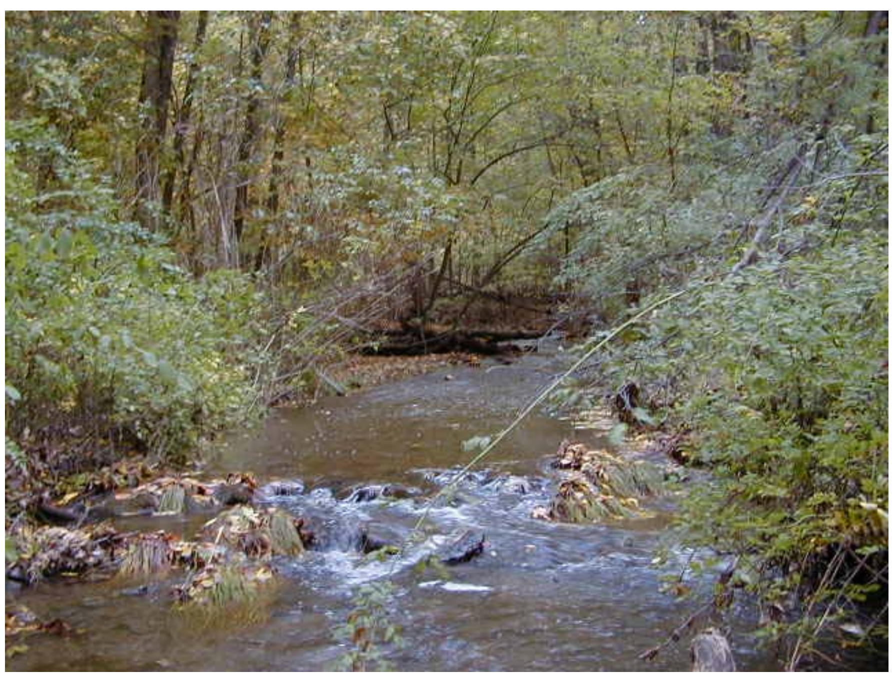
Background

The Natural Resource Management Plan for the Wappinger Creek Watershed was developed over a 5-year period to assist the 13 watershed communities in planning for the future of their water resources. The purpose of the plan is to provide information and recommendations that decision-makers may implement in their communities to ensure that sufficient quantity and quality of water will be maintained to promote and maintain economic growth and quality of life.

Contained entirely within Dutchess County, New York the Wappinger Creek originates in extensive headwater wetlands and lakes in the Town of Pine Plains in northern Dutchess County. Its watershed drains 134,871 acres in 11 towns and 2 villages and is fed by approximately 320 miles of tributaries. 38 miles long, the Wappinger Creek enters the Hudson River at Wappingers Falls, about one mile north of the New York City back-up water supply intake at Chelsea. Land use within the watershed is extremely diverse, ranging from agriculture and forestland in the north to extensive commercial and residential development in the south.

Growth pressure throughout the watershed has resulted in environmental degradation, especially in the lower portion south of Pleasant Valley. The eutrophication of watershed lakes and ponds is a symptom of the elevated nutrients (nitrates and phosphates) and excess sediment entering the watershed. An additional symptom of pollution is the increasing number of drinking water wells in the watershed contaminated with nitrate and bacteria. Nutrient loading and sedimentation will continue to threaten the designated uses of the lakes and streams in the watershed unless best management practices and land use planning for sustainable development are implemented at the local level. Because of the ongoing problems, the Dutchess County Water Quality Strategy Committee (DCWQSC) has designated the Wappinger Creek Watershed as the number one priority for nonpoint source pollution reduction in Dutchess County.

The DCWQSC formed the Wappinger Creek Watershed Planning Committee (WCWPC) in 1995 to address the problems specific to the Wappinger Creek Watershed. The WCWPC has carried out various activities in support of these goals and objectives, the results of which are included in this plan. This plan also suggests best management practices for reducing the nutrient and sediment loads reaching the water column, and strategies to help restore our water bodies so they meet their designated uses.



Data Collection and Results

Based on the review of the past and present studies, the WCWPC recommended that to target areas for nonpoint source pollution reduction and management in the Watershed it was necessary to complete an in-depth water quality study. To meet this need, a three-phase water quality study was conducted from summer 1997 to spring 2000. The first phase included monitoring of nutrients (nitrate and phosphate), fecal coliform bacteria, suspended material (including sediment), dissolved oxygen and physical parameters at twenty-four sampling sites. The second phase involved a study of the relationship between surrounding land use and the filtering capacity of wetlands for removal of nutrients, fecal coliform bacteria and suspended material. The third phase, initiated in 1998, is a comprehensive volunteer biological stream monitoring effort, which is still underway in 2000.

Phase One Results: The results of the phase one study showed that various land uses throughout the watershed contributed fairly high levels of nutrients and sediment to the Wappinger Creek and Wappinger Lake during the study period (1998-1999). When individual subwatersheds are analyzed, the data show that the Pleasant Valley East subwatershed is contributing the highest concentration of phosphate to the Wappinger Creek. Wappinger Creek Headwaters, Willow Brook and Great Spring Creek also showed concentrations of phosphate at or above levels that are likely to impact the ecological balance of the stream and lake. Although the Willow Brook Subwatershed contributes the smallest amount of flow to the Wappinger Creek of all the major tributaries, it contained the highest concentration of nitrates, almost 10 times the concentration in the headwaters streams. Other contributors of high nitrate concentrations are Hunns Lake Creek, Upton Lake Creek, Great Spring Creek and the Dutchess County Airport tributary. The East Branch is contributing the most sediment load to Wappinger Creek when compared to all other major tributaries. Other subwatersheds contributing significant amount of sediment to the watershed include Pleasant Valley East, Wappinger Creek Headwaters, Great Spring Creek, Dutchess County Airport, and Little Wappingers.

One of the more troubling findings was the amount of fecal coliform bacteria present in the subwatersheds. These high levels of fecal coliform bacteria may be discharging from poorly planned septic system drain fields, agricultural operations and residential stormwater runoff. In contrast, dissolved oxygen (DO) concentrations and percent saturation levels for oxygen tended to be healthy in the watershed, although an exception was the Wappinger Creek Headwaters, which consistently contained poor DO levels. In late summer and early fall DO levels in at the Headwaters sampling location approached levels that would stress cold water fisheries. The levels of nutrients, sediment and bacteria found in the phase one study indicate that remediation through best management practices is warranted.

Phase Two Results: Wetlands provide important functions in the landscape including flood control, groundwater recharge, and filtering of pollutants from surface water. The loss of wetlands can increase the threat of flood damage and increase the level of nutrients and sediment in streams and lakes. Since nutrient and sediment loading are the primary water quality impairments in the Wappinger Creek Watershed, it was important to analyze whether the wetlands in the Wappinger Creek watershed were providing nutrient and sediment removal functions. To meet this need, a study of the relationship between surrounding land use and the filtering capacity of wetlands for removal of nutrients and suspended material was conducted from November 1998 to January 2000. Three wetlands were chosen based on dominant land use in agricultural, forested and residential areas.

The results showed that the three wetlands of the Wappinger Creek basin studied in 1999 acted as sinks that trapped organic debris and subsequently released it following rainfall events during the non-growing season (October – March). The residential and agricultural wetlands appeared to be filtering nutrients and suspended materials during the growing season (May – September). The forested wetland system was a pass-through system that received and released relatively low concentrations of nutrients and suspended materials. During the study period, the residential wetland received the greatest amount of nutrients and the agricultural wetland received the greatest amount of suspended material. One of the more troubling findings of this study was the level of biological stress present in the agricultural wetland during the summer months, where high bacteria levels reduced dissolved oxygen placing stress on the aquatic life.

Phase Three Results: The third phase of the water quality monitoring program, a comprehensive volunteer biological stream monitoring effort, was initiated 1998 to provide an understanding of the biological health of the Wappinger Creek and its tributaries. The data collected by volunteers in 1998 and 1999 showed that macroinvertebrates in the Wappinger Creek were slightly impacted by sources of pollution in the watershed, and aquatic life at the Mountain Road site was moderately impacted. The most likely sources of the impairment are nutrient inputs and siltation. These findings are consistent with the New York State Department of Environmental Conservation's 1998 findings from the Wappinger Creek in Poughkeepsie.

Analysis of Sources of Pollution and Needed Pollutant Reductions

Based on the tributary monitoring data, the subwatersheds noted in the previous section as elevated for nitrates, phosphates, sediment and bacteria should be targeted first for implementation of best management practices to reduce nonpoint source pollution loading to the watershed. These include (from north to south) the Wappinger Creek Headwaters (phosphates and sediment), Willow Brook Subwatershed (nitrates and phosphates), East Branch (sediment), Pleasant Valley East subwatershed (phosphates and sediment), Great Spring Creek (phosphates, nitrates and sediment), and Dutchess County Airport (nitrates and sediment). Sources of these nutrients may include the rapid groundwater transport of local septic system effluent, residential fertilizer applications, atmospheric deposition and agricultural operations.

In the past, agricultural land uses were the major contributor of nutrients, sediment, and bacteria to the watershed. However, in Dutchess County agricultural land uses have declined approximately 21% from 1978 to 1997. It is now evident that residential land uses contribute equally to water quality degradation. With Dutchess County's population projected to grow 13% from 1980 to 2005, the burden will progressively be placed on residential land uses to improve and maintain good water quality.

The high levels of fecal coliform bacteria in the watershed may be resulting from poorly planned septic system drain fields and agricultural operations. Fecal coliform bacteria tend to parallel the amount of suspended material in the water. Knowing this, it is recommended that people do not use the Wappinger Creek or its tributaries as swimming areas after large storms or whenever the creeks have a high turbidity. This also means that the streams may not be meeting classifications established by the New York State Department of Environmental Conservation.

Suspended material (sediment) transport in the subwatersheds varies greatly. This variability makes it difficult to draw conclusions based on subwatershed land use. However, it is evident that a number of the subwatershed streams consistently produce median suspended material levels that exceed the criteria developed by the EMC for healthy streams in this watershed. The increased sedimentation may be due to the fact that during 1999 sampling, three of the twelve tributary sampling sites lost vegetated stream buffers. The destruction of the stream's vegetated buffer zone increases sediment and nutrient loading to the stream, warms water temperatures, and threatens the ability of aquatic life to reproduce. Eroding stream banks may also contribute to the phosphorous concentrations entering the watershed by releasing phosphorous from old agricultural fields that have since been converted to another land use.

Management Strategies for Achieving Water Quality Goals & Objectives

One of the primary objectives of this Management Plan is to identify the sources of nutrients and sediment to the watershed and to Wappingers Lake and to recommend management strategies to reverse the trend. To ensure that the Wappinger Creek and its tributaries will meet their designated uses, there are four main objectives that need to be accomplished.

First, we must protect a vegetated buffer zone or "riparian buffer" around the streams, lakes and wetlands to avoid erosion from streambanks and lakeshores and to allow for filtration of pollutants before they reach waterbodies. A number of references are available at the offices of the EMC and the SWCD to assist local governments, land developers and planners in designing riparian buffer areas.

Second, nitrate, phosphate and bacteria inputs from sewage disposal systems need to be addressed. Short-term solutions include the remediation of small package sewage treatment plants that cannot handle infiltration during rainfall events, and consequently discharge raw sewage to our surface waters. For individual septic systems, siting should <u>not</u> include a drain field that discharges near a local waterbody, wetland, or neighbor's drinking well. As a long-term solution, the Watershed Planning Committee recommends the development of SPDES discharge criteria that are based on stream health and account for cumulative impacts.

The third objective is to restructure current residential development practices using "smart growth" land use planning. An example of the need for smart growth is the evidence of widespread nitrate contamination in public water supply wells in the watershed. This contamination can be attributed to high-density development utilizing individual septic systems, stormwater runoff, and agricultural practices. Without water and sewer infrastructure and careful examination of soil types, nitrate contamination will most likely increase with an increase in population and residential growth.

Finally, agricultural operations that are currently contributing to the nonpoint source pollution problem should be identified. Large operations should be identified first for implementation of agricultural best management practices. Some of these operations are already involved in nonpoint source pollution reduction through the Agricultural Environmental Management Program. In addition, small farms and citizens with small animal populations should be given the tools to address water quality concerns.

Management strategies for achieving the four major objectives outlined above include wetland management and protection, Best Management Practices, land acquisition techniques, incentives, and education. Each of these categories of management strategies is outlined in the plan, including 27 wetland areas in the watershed that are identified as top priority for management and protection. These wetlands encompass 3,345 acres, or 40% of the wetlands in the watershed. In the future, the remaining 60% of wetlands in the watershed should also be examined for management strategies.

Inventory of Land Use Regulations

An inventory of the land use regulations in the thirteen watershed municipalities was compiled by the Land Use Law Center at Pace University School of Law in fall of 1999 and spring of 2000. The results of this inventory have been compiled into a "Land Use Regulation Comparison Chart", which is included as an appendix in the Management Plan. To explore local land use regulations further, the Land Use Law Center created a "Watershed Analysis", which is a compilation of rules and regulations relating to watershed management. The Watershed Analysis was developed using the Watershed Template, which is part of a larger system created by the Land Use Law Center called the Land Use Regulation Diagnostic

System. The purpose of the Diagnostic System is to create a useable summary of all of the local land use regulations in a particular municipality and to assist local leaders in analyzing those regulations in different ways.

While each of the thirteen watershed communities has enacted their own unique set of land use regulations, they have recognized the necessity of working cooperatively to protect their water resources. To reach this goal, twelve communities passed resolutions in 1999 supporting development of an intermunicipal organization supported by a grant from the New York State Department of State. The draft mission statement of the intermunicipal organization is: "To share a number of common goals including the prevention of non-point source pollution of the watershed, the remediation of existing pollution, the preservation of open space, and natural resources and the expansion of economic activities consistent with the watershed environment."

Implementation of the Plan

The Wappinger Creek Watershed Planning Committee (WCWPC) and the watershed partners are committed to carrying out implementation of this Watershed Management Plan. Over the next year, grants from the NYS Department of State and the Hudson River Estuary Program will begin the implementation process. However, the WCWPC should continue to research funding sources and increase involvement by watershed partners.

Throughout this Management Plan, research needs and information gaps have been noted. In particular, more research is needed on wetlands identified for protection. A streambank erosion study initiated in summer of 2000 should be completed to provide a basis for riparian buffer enhancement projects. The lake monitoring pilot study on Long Pond should be expanded to include all lakes in the watershed. Funding should be obtained to complete the watershed-modeling project for all subwatersheds. A cumulative impact analysis of SPDES discharge sites along the Wappinger Creek and into Wappingers Lake should be done including total loading of nutrients. Based on the results of the cumulative impact study, the Watershed Planning Team should work with the NYSDEC to reduce these inputs and develop total maximum daily load allocations for the Wappinger Creek. A groundwater study including the interaction of nonpoint source pollution between surface and groundwater has also been identified by the watershed municipalities as top priority. Finally, the watershed municipalities have identified the need for training in land use techniques that will encourage sustainable communities.

One of the key components of implementation of this Management Plan is public involvement. Therefore the watershed planning team recommends that public outreach and education be continued for a wide diversity of audiences. Most important, the local boards in watershed municipalities should be involved in the process of implementation through the intermunicipal organization and the Wappinger Creek Watershed Planning Committee.

The watershed planning team looks forward to working with municipalities, community groups, businesses and residents in implementation of this Management Plan. For more information about the information in this Plan or to submit suggestions and comments, please contact the Dutchess County Environmental Management Council at (914) 677-5253 or the Dutchess County Soil and Water Conservation District at (914) 677-8011.

I. Introduction

Purpose of Plan

The Wappinger Creek Watershed Management Plan has been developed over a 5-year period, as a living document, to assist the 13 watershed communities in planning for the future of their water resources. The purpose of this plan is to provide information and recommendations that decision-makers may implement in their communities to ensure that sufficient quantity and quality of water will be maintained to promote and maintain economic growth and quality of life.

In the following pages, information is presented about the watershed including surface and groundwater, freshwater wetlands, land use and ecology. An analysis of the sources of pollution and needed pollutant reductions is made. Management strategies using various techniques are outlined in this plan including land-use planning, septic system education, and best management practices for residential, urban, and agricultural land-uses. Finally, an implementation plan is suggested and funding sources are identified.[1]

General Description

Contained entirely within Dutchess County, New York the Wappinger Creek originates in extensive headwater wetlands and lakes in the Town of Pine Plains in northern Dutchess County. Its watershed drains 134,871 acres in 11 towns and 2 villages. The Wappinger Creek is fed by approximately 320 miles of tributaries, including (north to south) Cold Spring Creek, Hunns Lake Creek, Tamarack Creek, Grist Mill Creek, Willow Brook, East Branch Wappinger Creek, Upton Lake Creek, Little Wappinger Creek and Great Spring Creek (Map 1).

38 miles long, the Wappinger Creek enters the Hudson River at Wappingers Falls, about one mile north of the New York City back-up water supply intake at Chelsea. Land use within the watershed is extremely diverse (Table 1, Map 2), ranging from agriculture and forestland in the north to extensive commercial and residential development in the south.

Table 1. Land Use - Wappinger Creek Watershed

Land Use in the Wappinger Creek Watershed	
49.3%	Forest
22.0%	Agriculture
18.3%	Residential
6.2%	Wetlands & Waterways
1.5%	Public & Outdoor Recreation
1.5%	Commercial & Industrial
1.2%	Transportation

Problem Statement

Growth pressure throughout the watershed has resulted in environmental degradation, especially in the lower portion south of Pleasant Valley. The EPA's recently released "Index of Watershed Indicators"[2] shows that Dutchess County experienced greater than 7% growth in population from 1980-1990, the highest category indicated in the report. Even more impact from growth may occur in the near future, as predicted by the Dutchess County Forecasting Project[3]. Conducted in 1997, the Forecasting Project predicts that Dutchess County will grow 7.64% by 2010 and 19.8% by 2020. Associated with this growth, nutrient loading (nitrates and phosphates) and sedimentation will continue to threaten the designated uses of the lakes and streams in the watershed unless best management practices and land use planning for sustainable development are implemented at the local level.

Examples of degraded water quality are as follows:

- High fecal coliform bacteria counts, sedimentation and excessive weed growth have rendered Wappingers Lake useless for swimming, boating and fishing which historically were profitable operations.
- Swimming areas on the Wappinger Creek in the towns of LaGrange, Pleasant Valley, and Village of Wappingers Falls were forced to close due to high fecal coliform bacteria levels.
- From 1950 to 1990, high sediment loads in the Wappinger Creek and its tributaries caused

the mean depth of 88-acre Wappingers Lake to drop from 15 feet to 6 feet.

Because of the ongoing problems, the Dutchess County Water Quality Strategy Committee* (DCWQSC) has designated the Wappinger Creek Watershed as the #1 priority for nonpoint source pollution reduction in Dutchess County. The DCWQSC formed the Wappinger Creek Watershed Planning Committee in 1995 as a subcommittee to address the problems specific to the Wappinger Creek Watershed. The problems with nonpoint source pollution are exemplified by Wappingers Lake, which has been included in the New York State Department of Environmental Conservation (NYSDEC) Priority Waterbody List† every year since 1990. Also included on the NYSDEC Priority Waterbody List are the main stem of Wappinger Creek, Hunns Lake, Hunns Lake Creek, Long Pond, Silver Lake, Twin Island Lake, and Upton Lake. Nutrient loading and sedimentation are the primary problems in these water bodies (see summary sheets for each water body in Appendix 2).

Figure 1: Top Ten Threats to the Watershed Identified by Participants at the November 1998 Watershed Conference

1. Nonpoint source pollution, especially excess nutrients, sediment and bacteria
2. Lack of interagency/municipal cooperation
3. Over-development within the watershed
4. Loss and/or fragmentation of habitat and the accompanying loss of biodiversity
5. Lack of stream management and enforcement of existing regulations
6. High property taxes promote non-sustainable agriculture and forestry practices and replacement of agriculture by residential and commercial land uses
7. Lack of information regarding the public water supply, how it works and what needs to be done to protect surface and groundwater
8. Lack of funds, volunteers and the public interest needed to implement a watershed education program
9. Over-development causes excessive water consumption that results in reduced base flow and an increase in impervious surfaces that decreases recharge
10. Division of interests and lack of communication among groups that are using the same resource

This Wappinger Creek Watershed Management Plan (the Plan) suggests best management practices for reducing the nutrient and sediment loads reaching the water column, and strategies to help restore our water bodies so they meet their designated uses.

Groundwater quality and quantity in the watershed has also been affected by land use practices. Public water supply wells in the lower watershed have begun to show nitrate contamination from high-density development utilizing individual septic systems (data available from the Dutchess County Department of Health, Appendix 3). During the drought of 1999, water quantity became a critical issue and resulted in water restrictions in 7 of the watershed towns and villages that utilize groundwater for both public and private water supplies. Since 75% of the municipalities in the watershed rely on groundwater exclusively for drinking water, protection of groundwater quality and quantity has been identified as a critical issue for the watershed.

Goals and Objectives

The Wappinger Creek Watershed Planning Committee developed a mission statement, goals and objectives in 1995 as outlined below:

* The Dutchess County Water Quality Strategy Committee is a consortium of county, state and federal agencies relating to water resources; see Appendix 4 for a list of agencies involved.

† The NYSDEC Priority Waterbody List is prepared every five years based on data collected by NYSDEC and information submitted by local agencies. The list classifies water-bodies as precluded, impaired, stressed or threatened depending on the level of pollutants identified. The priority water list identifies those waterbodies in need of restoration efforts to restore their best usage.

WAPPINGER CREEK WATERSHED PLANNING COMMITTEE

MISSION STATEMENT
To identify and prioritize problematic areas and cumulative impacts within the Wappingers watershed and involve all watershed parties and municipalities in developing and implementing remediation, best management practices (BMP's) and prevention measures, so that water quality and biotic integrity can be maintained and improved on a sustainable basis.

PROGRAM GOALS
- *To protect and enhance water quality*
- *To manage growth & development in the watershed*
- *To protect critical environmental resources such as wetlands, fish and wildlife habitat, unique geological features (waterfalls, scenic vistas, stream corridors)*
- *To promote recreation and tourism*
- *To promote business and industry in the watershed*

PROGRAM OBJECTIVES
- *To identify nuisance species in the watershed*
- *To identify the primary pollutants causing the problem, including point and nonpoint sources including the sources of pollutants*
- *To reduce the amount of pollutants and nutrients entering the watershed*
- *To maintain fish and wildlife populations and biodiversity*
- *To encourage public participation and provide opportunities for public input*
- *To identify business and industry that can coexist and be beneficial for the watershed*
- *To offer assistance to businesses in developing pollution prevention plans*
- *To encourage municipalities to cooperate and adopt similar procedures for protecting the watershed such as erosion and sediment control ordinances*

PUBLIC INVOLVEMENT GOALS
- *To facilitate understanding, involvement and support for the program objectives designed to improve water quality*

PUBLIC INVOLVEMENT OBJECTIVES
- *To increase public understanding of the problems that affect water quality in the watershed*
- *To obtain information from the public about watershed issues*
- *To gain public support for a proposed course of action*
- *To encourage the public to take actions to achieve program goals*
- *To provide education for town planners, zoning administrators and board members*

Past and Current Activities

The Wappinger Creek Watershed Planning Committee has carried out various activities in support of these goals and objectives, the results of which are included in this plan. These activities include:

- A land use study supported by the Rural New York Grant Program[4].
- An EPA approved water quality monitoring program[5] through a partnership with Marist College, the Institute of Ecosystem Studies, AmeriCorps, and the Mid-Hudson Chapter of Trout Unlimited.
- An economic impact study[6] of recreational use of the Wappinger Creek watershed conducted by the Bureau of Economic Research at Marist College and Mid-Hudson Trout Unlimited.

- An education program including presentations to watershed town boards and planning boards, a Watershed Conference in November of 1998 attended by 110 people, a Lake Conference in Spring 2000 and involvement in the "Watershed Bridges" school program.
- The Agricultural Environmental Management (AEM) Program conducted by the Dutchess County Soil and Water Conservation District.
- A volunteer stream team program in the town of Pleasant Valley, NY designed to conduct physical stream surveys on the Wappinger Creek and tributaries and assess areas of potential streambank erosion problems. The intent is to expand the program to every town in the watershed as volunteer interest and funding allow.

II. Description of the Watershed

Watershed Boundary

The Wappinger Creek Watershed covers portions of 11 towns and 2 villages (Table 2, Map 1). Portions of the watershed are included in the Towns of Pine Plains, Milan, Stanford, Clinton, Washington, Hyde Park, Pleasant Valley, Poughkeepsie, La Grange, Wappinger, and Fishkill and the Villages of Millbrook and Wappingers Falls.

Table 2. Municipalities in the Watershed

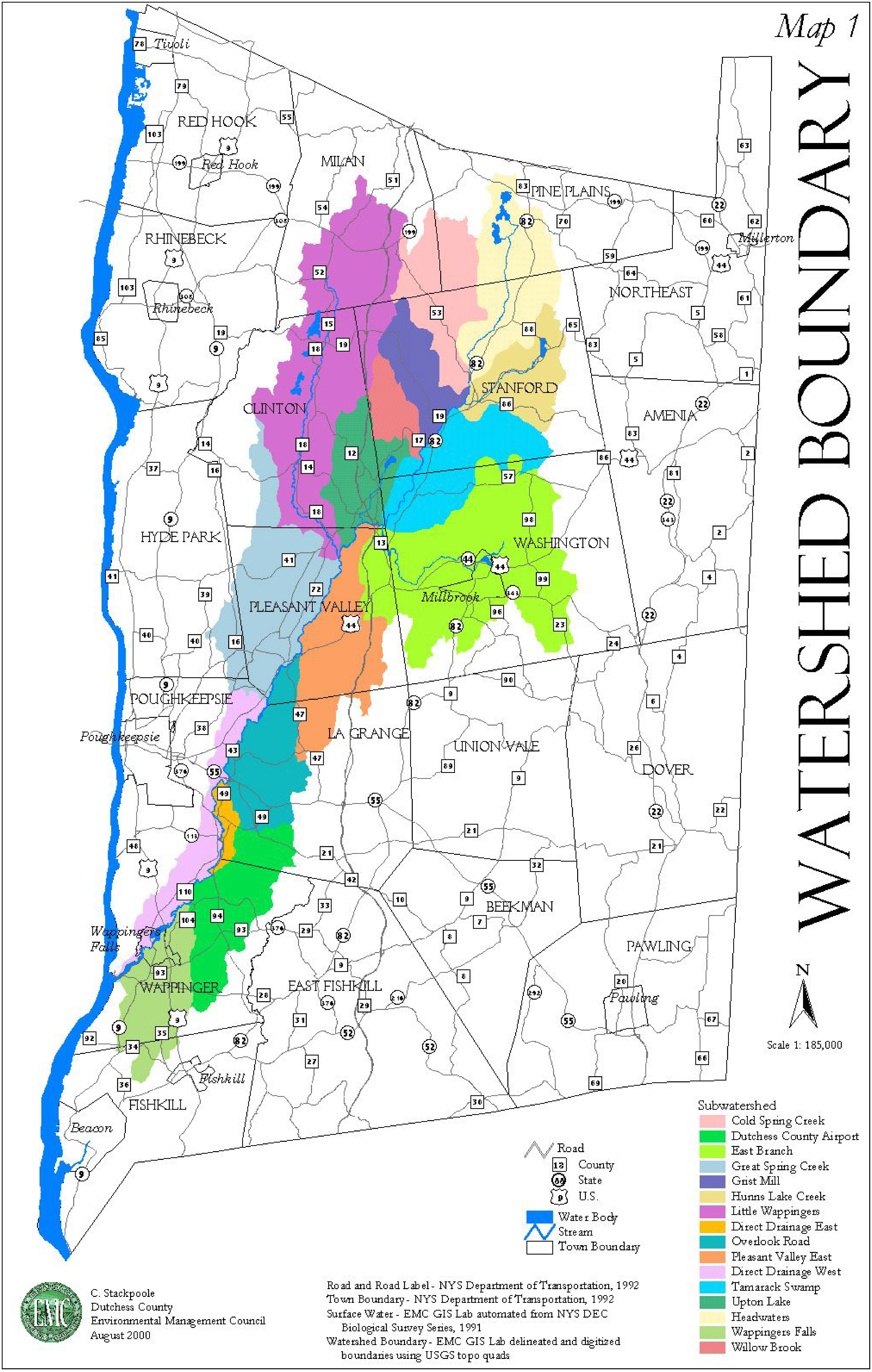
Municipality	% of Municipality in the Watershed	% of Watershed in the Municipality
PINE PLAINS	35%	5%
MILAN	35%	7%
CLINTON	70%	13%
STANFORD	80%	20%
WASHINGTON	60%	16%
PLEASANT VALLEY	90%	14.5%
POUGHKEEPSIE	35%	4%
LA GRANGE	50%	8%
WAPPINGER	70%	8.5%
HYDE PARK	7%	1%
FISHKILL	1%	1%
VILLAGE OF WAPPINGERS FALLS	100%	1%
VILLAGE OF MILLBROOK	100%	1%

Subwatersheds

The Watershed is divided into 16 subwatersheds to facilitate study and planning (Table 3, Map 1). The subwatersheds were delineated by the Dutchess County Environmental Management Council (EMC) on United States Geological Survey (USGS) maps and subsequently digitized in the EMC's Geographic Information System (GIS).

Table 3. Subwatershed Acreage. Source: Delineated and Digitized from USGS Topographical Quadrangles by the Dutchess County Environmental Management Council

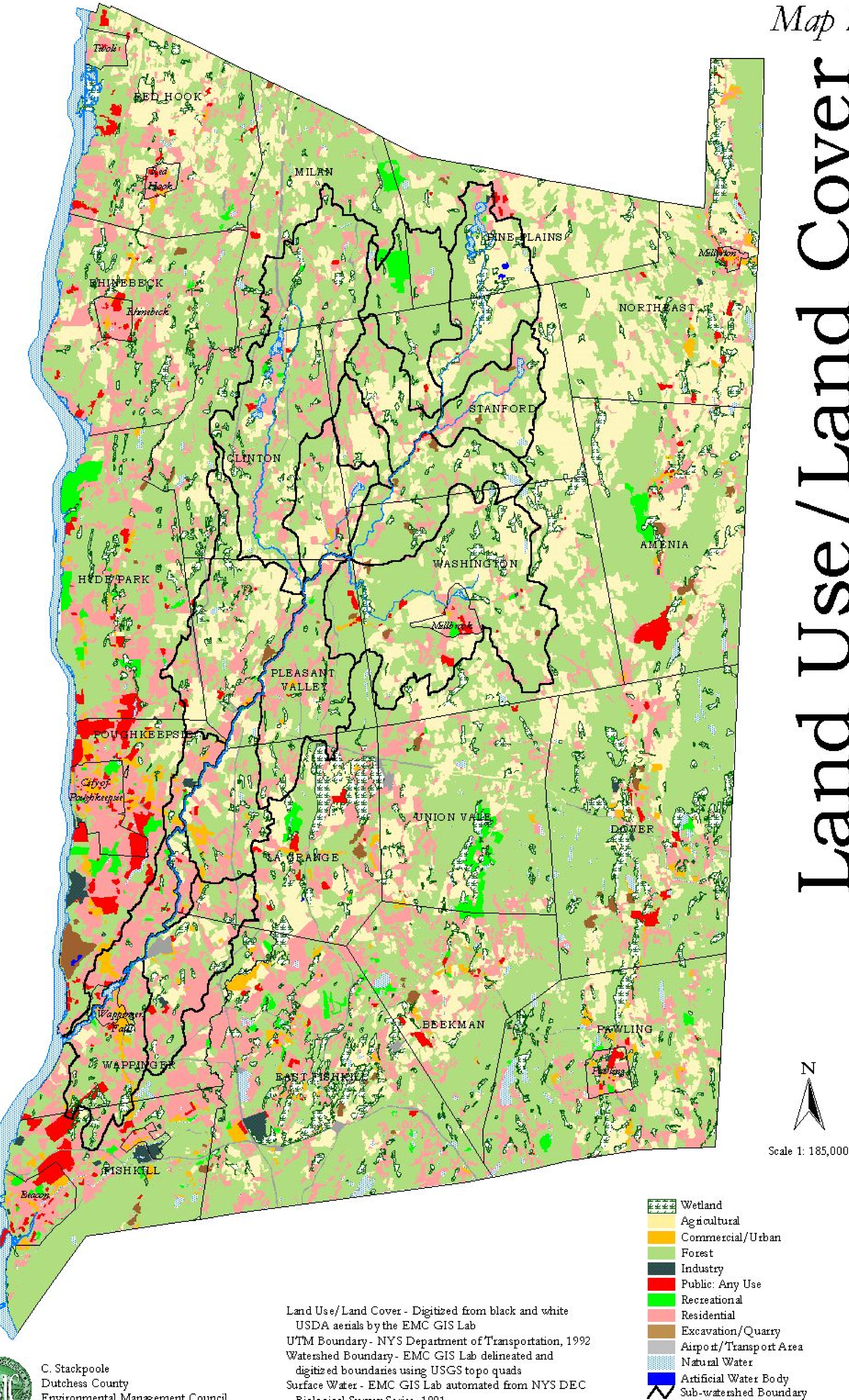
ID #	Subwatershed Grouping	Total Area (Acres)
1	Wappinger Creek Headwaters	9,430
2	Cold Spring Creek	7,454
3	Little Wappinger	21,296
4	Hunns Lake Creek	5,407
5	Grist Mill	4,257
6	Willow Brook	2,545
7	Tamarack Swamp	8,392
8	Upton Lake	5,523
9	East Branch	21,387
10	Great Spring Creek	12,068
11	Pleasant Valley East	8,967
12	Overlook Road	6,762
13	Direct Drainage West	5,369
14	Direct Drainage East	1,099
15	Dutchess County Airport	7,888
16	Wappinger Falls	6,519
Water-ways	Wappinger Creek and Wappinger Lake	508
TOTAL		134,871



Map 1
WATERSHED BOUNDARY
Tivoli
RED HOOK
Red Hook
MILAN
PINE PLAINS
Millerton
RHINEBECK
Rhinebeck
NORTHEAST
STANFORD
CLINTON
AMENIA
HYDE PARK
WASHINGTON
PLEASANT VALLEY
Millbrook
POUGHKEEPSIE
Poughkeepsie
LA GRANGE
UNION VALE
DOVER
BEEKMAN
PAWLING
Pawling
Wappingers Falls
WAPPINGER
EAST FISHKILL
Fishkill
FISHKILL
Beacon
N
Scale 1: 185,000
Road
County
State
U.S.
Water Body
Stream
Town Boundary
Subwatershed
Cold Spring Creek
Dutchess County Airport
East Branch
Great Spring Creek
Grist Mill
Hunns Lake Creek
Little Wappingers
Direct Drainage East
Overlook Road
Pleasant Valley East
Direct Drainage West
Tamarack Swamp
Upton Lake
Headwaters
Wappingers Falls
Willow Brook
C. Stackpoole
Dutchess County
Environmental Management Council
August 2000
Road and Road Label - NYS Department of Transportation, 1992
Town Boundary - NYS Department of Transportation, 1992
Surface Water - EMC GIS Lab automated from NYS DEC Biological Survey Series, 1991
Watershed Boundary - EMC GIS Lab delineated and digitized boundaries using USGS topo quads

Map 2

Land Use / Land Cover



Land Use/Land Cover - Digitized from black and white USDA aerials by the EMC GIS Lab

UTM Boundary - NYS Department of Transportation, 1992

Watershed Boundary - EMC GIS Lab delineated and digitized boundaries using USGS topo quads

Surface Water - EMC GIS Lab automated from NYS DEC Biological Survey Series, 1991

C. Stackpoole
Dutchess County
Environmental Management Council
August 2000

Surface Water

The Wappinger Creek is the dominant feature of the Watershed, running 37.95 miles from Pine Plains to the Hudson River in the Town of Wappinger. The Wappinger Creek is fed by approximately 320 miles of tributaries, including (north to south) the Cold Spring Creek, Hunns Lake Creek, Tamarack Creek, Grist Mill Creek, Willow Brook, East Branch Wappinger Creek, Upton Lake Creek, Little Wappinger Creek and Great Spring Creek (Map 1).

There are approximately 1,694 acres of lakes and ponds in the Watershed. The largest are listed in Table 4, along with the NYSDEC Classification for each waterbody. Waterbodies in New York State are regulated under Article 15 (Use and Protection of Waters) and Article 17 (Water Pollution Control) of the Environmental Conservation Law. Under these laws, a permit is required to disturb a protected stream, its bed or banks, or to remove from its bed or banks sand, gravel or other material. Banks are defined as 50 feet from the mean high water mark, with some exceptions. Water Quality Classifications and Standards of Quality and Purity are defined in the NYS Water Quality Regulations (6NYCRR), Parts 700-705. A protected stream is classified as C(t) or higher, as defined in Table 5. These classifications may differ depending on the section of the stream in question; for example Tamarack Creek has four different classifications from the headwaters to the mouth where it enters Wappinger Creek.

The NYS Water Quality Classifications in Table 5 are based on the best use of the water body. The NYSDEC's Priority Waterbody List (PWL) was developed to address those waterbodies that do not meet their intended uses due to various pollution sources. Wappingers Lake, Silver

Table 4. Lakes and Ponds Over 20 Acres in the Wappinger Creek Watershed (Source: Dutchess County Environmental Management Council GIS Database – Polygon coverage of ponds and lakes digitized from USGS biological stream survey maps)

Lake Name	Municipality	Approximate Size in Acres	NYSDEC Classification
Bontecou Lake	Washington	123	Not classified
Dieterich Pond	Millbrook	32	B(T)
Halcyon Lake	Pine Plains	30	D
Hunns Lake	Stanford	65	B
Long Pond	Clinton	82	AA
Shaw Pond	Washington	28	B(T)
Mud Pond	Clinton	24	B
Silver Lake	Clinton	123	AA(T)
Stissing Lake	Pine Plains	77	B
Thompson Pond	Pine Plains	79	B
Twin Island Lake	Pine Plains	61	B
Upton Lake	Stanford	43	B
Wappingers Lake	Wappingers Falls	88	C(T)

Lake, Long Pond, Hunns Lake, Upton Lake, and Twin Island Pond are listed on the PWL (see detailed PWL summary sheets in Appendix 2).

Surface and groundwater in New York State is also regulated through the State Pollutant Discharge Elimination System (SPDES). The objective of the SPDES program is to eliminate the pollution of New York waters and to maintain the highest quality of water possible, consistent with public health and enjoyment of the resource, protection and propagation of fish and wildlife, and industrial development. Under SPDES, any construction or use of an outlet or discharge pipe of wastewater when discharging more than 1,000 gallons per day (averaged over a seven day period) to a stream, lake or river must obtain a permit from the NYSDEC. Any discharge of more than 10,000 gallons to groundwater (such as a subsurface sewage disposal system or septic system) must also obtain a SPDES permit. A discharge to groundwater of 1,000 to 10,000 gallons may be approved under a statewide general permit. In all cases, both the Dutchess County Department of Health and the NYSDEC must approve the design of the sewage disposal system. Periodic testing of the effluent is required in most cases to ensure that the quality of the water is meeting the limits set in the permit.

Table 5. Water Quality Classifications and Standards of Quality and Purity (Source: NYSDEC)

Part 701 - Classifications (freshwater)
N - Natural – Drinking (no disposal of sewage allowed)
AA-S - Drinking (no disposal of sewage allowed)
A-S - Drinking (International boundary waters)
AA - Drinking (disinfection required)
A - Drinking (coagulation, sedimentation, filtration and disinfection required)
B - Bathing – primary contact recreation
C - Secondary contact recreation – fishing and boating; will support fish propagation
D - Fishing; will not support fish propagation
Part 703 - Standards of Quality and Purity
(T) indicates a waterbody that will support trout survival
(TS) indicates a waterbody that will support trout spawning
Chemicals, pH, bacteria, and turbidity are also regulated

Vegetation

Vegetation in the Watershed can be grouped into six land use-vegetation types, these are forest (trees over 30 feet tall), brushland, plantations, wooded wetlands, non-wooded wetlands, and agricultural and developed land. Plant communities vary locally depending on geology, human uses, history, and other factors.

Forest, brush, or inactive land covers more than 53% of the Watershed. Brushland vegetation consists of numerous species that includes shrub patches, small trees, and coarse herbs. Red cedar, gray birch, and gray dogwood are among the most typical brushland tree species in the Watershed.

Upland forest areas are primarily comprised of northern hardwoods, including but not limited to sugar maple, red maple, red oak, white oak, chestnut oak, black cherry, American beech, black birch, yellow birch, black locust, and white ash. Plantations, which are stands of planted trees of any size, typically consist of pure stands or alternating patches of conifers. Certain popular plantation species, such as Norway spruce and European larch are not native to this area.

Wetland vegetation is quite diverse, reflecting the many different types of wetlands in the Watershed. Common wetland tree species include red maple, swamp white oak, silver maple, tamarack, slippery elm, willows and red ash. American elm was a common wetland tree before Dutch elm disease decimated the elm population. Pussy willow, alder, buttonbush, red osier dogwood and silky dogwood are common shrub species. Grasslike plants, such as bulrushes, tussock sedge, reed and cattail are characteristic of marshes. Water-loving plants include pickerelweed, arrow arum, arrowhead, wild rice, water lily and spatterdock. Common non-woody broad-leaved plants that can be found in semi-dry wetlands include skunk cabbage, marsh marigold, purple loosestrife, joe-pye weed, boneset, and jewelweed.

There are ten rare plant species listed by the New York Natural Heritage Program (NYNHP) that occur in the watershed. Rare plants include Rocky Mountain sedge, Bicknell's sedge, False hop sedge, Weak Stellate sedge, Black sedge, Davis' sedge, and Willdenow's sedge. Other rare herbaceous plants are Mountain pyrola, yellow milkwort and smartweed dodder. The NYNHP has documented a rare plant community in the northern part of the watershed, the Calcareous Cliff habitat. Also, the Wappinger Creek Estuary below Wappingers Falls was designated a Significant Tidal Habitat by the NYS department of State in 1990. Rare species in the estuary area include grassleaf arrowhead, subdulate arrowhead, kidney leaf mud plantain and Maryland bur-marigold[7].

The number of rare plants existing in the watershed is a product of two main factors. First, the high carbonate content of the bedrock in the watershed promotes certain rare habitats and species (such as the Calcareous Cliff habitat) that cannot exist where the bedrock is more acidic. Second, there are still many areas of open space (both protected and unprotected) that have not been disturbed by development.

Value of Vegetation: Plants provide food, building materials, fuel and wildlife habitat and serve as buffers and filters to protect water quality. Vegetation slows flood flows, builds up the soil and holds it in place, replenishes oxygen supplies, absorbs noise, gives privacy, and moderates air temperatures and wind exposure near the ground. As they grow, reproduce, die, and decompose, plants regulate the movement and concentrations of dissolved nutrients and minerals in soils and water. In addition to protecting the environment, vegetation buffers enhance the value of developed or agricultural land by providing windbreaks, natural air conditioning, shade, privacy, erosion control, and aesthetic charm.

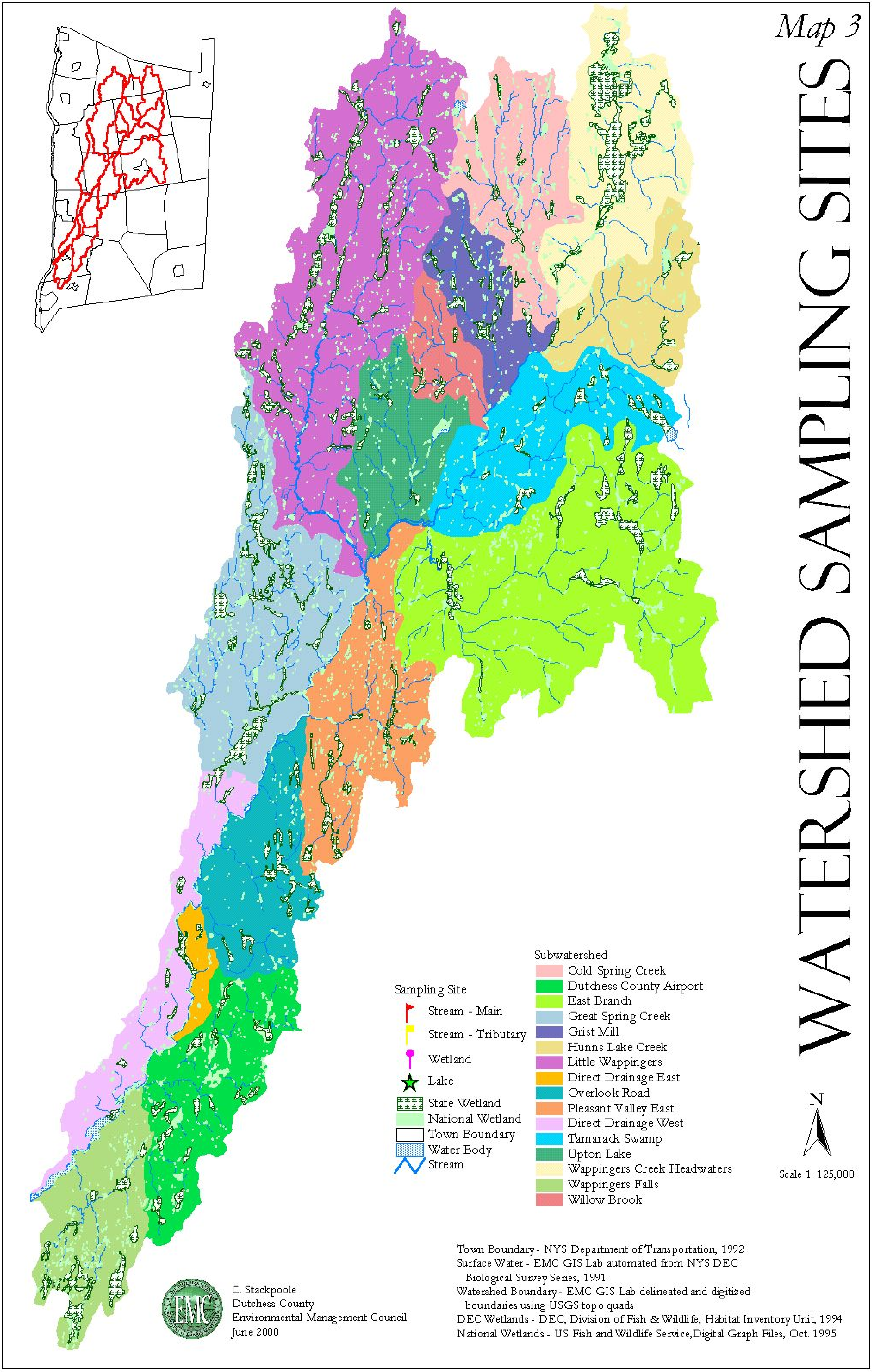
Wetlands

Wetlands, both wooded and non-wooded, cover 6.2% of the Watershed or 8,362 acres (Map 3 and individual subwatershed maps #10-25). Wetlands are important for flood control, pollutant filtering, recreation, wildlife habitat, endangered species habitat and open space value. They range from swamp or seasonally flooded areas to lands that are permanently covered with a foot or more of water.

Approximately 7,553 acres of wetlands in the Watershed are regulated by the NYSDEC under Article 24 of the Environmental Conservation Law. This law regulates wetlands greater than 12.4 acres or wetlands of unusual local importance less than 12.4 acres through a permit program. The remaining 809 acres of smaller wetlands are regulated under section 404 of the Federal Clean Water Act by the US Army Corps of Engineers* (USACOE). The Town of LaGrange is the only town in the watershed that has a local wetland law regulating wetlands smaller than 12.4 acres at the local level.

Soils as Indicators of Important Wetlands: Wetlands that overlie peat soil, which is rich in organic matter and often acidic, are called bogs. Typical bog plants include sphagnum moss, cranberry, leatherleaf, pitcher plant, sundew, cottongrass, and conifers. Bogs are relatively

* For information and copies of the state and federal regulations pertaining to wetlands contact the NYSDEC, the USACOE or the Dutchess County Environmental Management Council (for addresses see Appendix 4).


Map 3
WATERSHED SAMPLING SITES
Sampling Site
Stream - Main
Stream - Tributary
Wetland
Lake
State Wetland
National Wetland
Town Boundary
Water Body
Stream
Subwatershed
Cold Spring Creek
Dutchess County Airport
East Branch
Great Spring Creek
Grist Mill
Hunns Lake Creek
Little Wappingers
Direct Drainage East
Overlook Road
Pleasant Valley East
Direct Drainage West
Tamarack Swamp
Upton Lake
Wappingers Creek Headwaters
Wappingers Falls
Willow Brook
N
Scale 1: 125,000
Town Boundary - NYS Department of Transportation, 1992
Surface Water - EMC GIS Lab automated from NYS DEC
Biological Survey Series, 1991
Watershed Boundary - EMC GIS Lab delineated and digitized
boundaries using USGS topo quads
DEC Wetlands - DEC, Division of Fish & Wildlife, Habitat Inventory Unit, 1994
National Wetlands - US Fish and Wildlife Service, Digital Graph Files, Oct. 1995
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Dutchess County
Environmental Management Council
June 2000

rare in the Watershed, and sometimes contain orchids, Bog turtles and other species listed as threatened or endangered in New York State.

Wetlands in the Watershed located on Hoosic soils are often an indicator of Blanding's turtle habitat, a threatened species in New York State.

For additional information on identifying wetland plants and ecological types the following references are valuable: Biodiversity *Manual for the Hudson River Estuary Corridor*[8] recently completed by Hudsonia, Ltd.; *National List of Plants that Grow in Wetlands*[9], NYSDEC Part 664-Freshwater Wetlands Mapping and Classification Regulations (Appendix 6), and the NYSDEC Freshwater Wetlands Delineation Manual.

Wetland providing agricultural runoff filtering benefits in the Town of Pine Plains

Wetland Loss: The EPA's Index of Watershed Indicators shows that a moderate level of wetland loss has been experienced by the region, and more than 5 wetland or aquatic species are known to be at risk, the highest category for species risk in the report. In order to reverse this trend and provide management strategies for the remaining wetlands, it is important to identify those wetlands that are biologically significant or hold special value for flood protection or water quality. To provide this analysis a special section on wetlands identified for management and protection is included in Chapter VI, "**Management Strategies for Achieving Water Quality Goals & Objectives".**

Topography, Drainage and Floodplains

The topography of the Wappinger Creek drainage basin is varied, ranging from the rocky slopes of Stissing Mountain, the highest point in the watershed at 1,403 feet above sea level in Pine Plains, to sea level at the Hudson River in New Hamburg. Most of the principal tributaries are permanent streams with elevations of 400 to 600 feet and average gradients of 10 to 15 feet per mile. Three primary branches, the Little Wappinger, the Main Branch, and the East Branch, drain the northern area before converging near Salt Point in the town of Pleasant Valley.

Much of the land along Wappinger Creek and its major tributaries is subject to flooding (Map 4). The section downstream of the confluence of the Little Wappinger and the East Branch, at Salt Point, is especially floodprone. This flood potential is due to the following three factors: 1) the Little Wappinger and the East Branch are the two largest tributaries of the Wappinger Creek; 2) these two tributaries are both located in the northern half of the watershed; and 3) the Little Wappinger and the East Branch enter the main stem of the Wappinger Creek less than 3 miles apart. Therefore, the entire drainage from the expansive upper basin, which is three times as large as the lower portion of the watershed, funnels through the Wappinger Creek at Salt Point.

The lower portion of the Wappinger basin is more urban than the upper basin, and contains large expanses of land sealed by pavement or buildings. This urbanization aggravates flood hazards by increasing the volume and speed of storm runoff; this increase, in turn, often overloads the storm drainage capacity of lowlands along the creek. Several settlements in these floodplain lowlands, including the hamlet of Pleasant Valley, the Overlook section of the town of LaGrange, and the Shady Brook Trailer Park in the town of Poughkeepsie have suffered severe flood damage in the past.

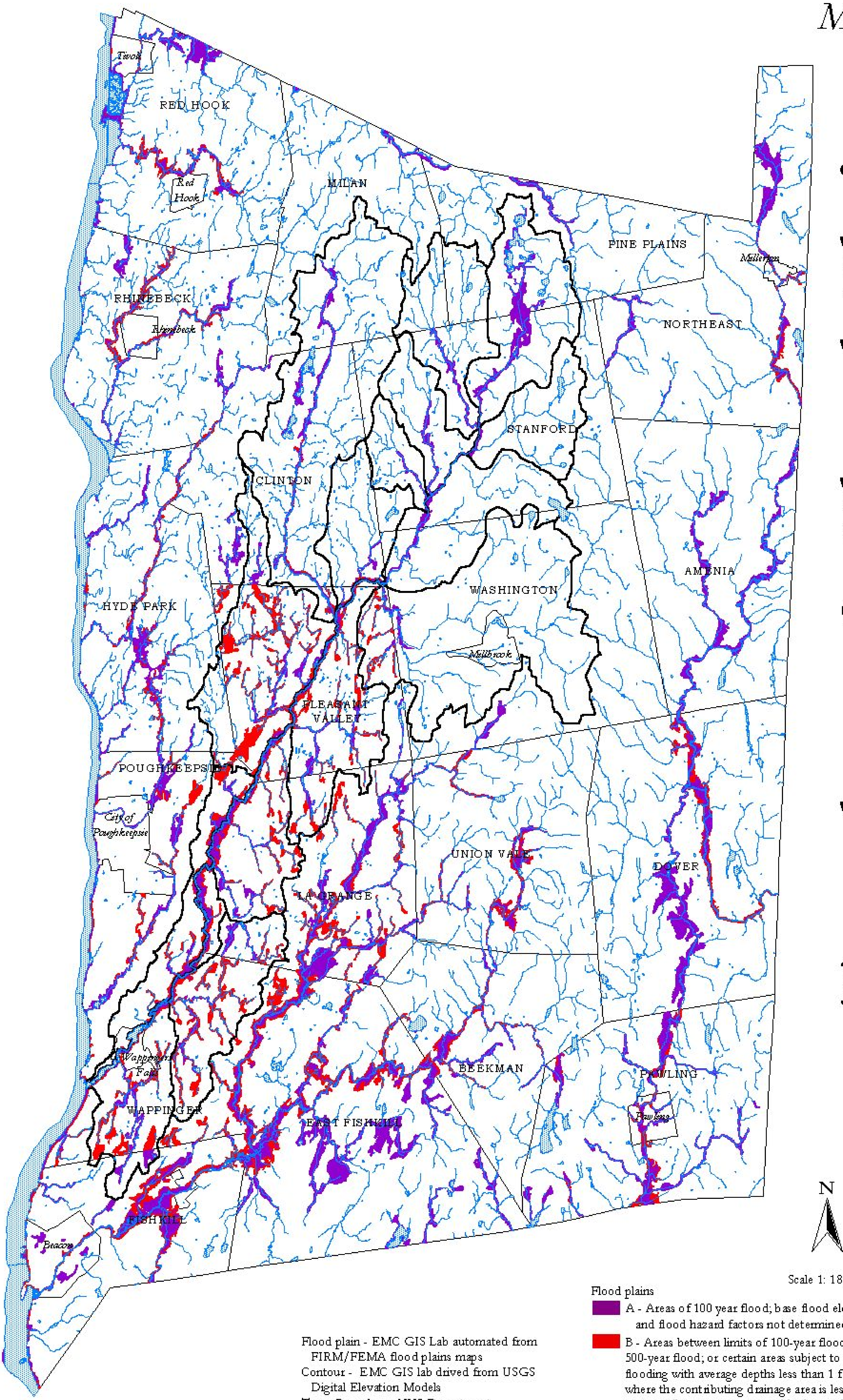
The Federal Emergency Management Administration (FEMA) has prepared detailed maps of the 100-year floodplains in Dutchess County (Map 4). These maps are used to determine low cost federal flood insurance rates and to develop local land use controls that comply with FEMA's requirement. Each municipality regulates development and activity in the floodplain through adoption of a local flood damage prevention law and/or a similar provision in the zoning code. Municipalities must enforce these laws or risk losing federal flood insurance benefits. Table 6 shows the percentage of floodplain acreage within the watershed municipalities.

Table 6. Floodplain Acreage by Municipality. Dutchess County Department of Planning, January 1985

Municipality	Approximate Floodplain Acreage	Approximate percentage in Wappinger Watershed	Percentage of Municipality
Clinton	1,227	85%	4.9
Fishkill	1,862	10	10.9
Hyde Park	1,440	0	6.1
LaGrange	4,779	50	19.2
Milan	345	65	1.5
Pine Plains	955	60	4.8
Pleasant Valley	3,930	95	18.5
Poughkeepsie	2,260	65	12.1
Stanford	977	100	3.0
Wappinger	3,563	60	21.0
Washington	393	60	1.1
Village of Millbrook	121	100	10.3
Village of Wappingers Falls	110	100	14.1

Map 4

Topology & Flood Plains



Flood plain - EMC GIS Lab automated from FIRM/FEMA flood plains maps
Contour - EMC GIS lab drived from USGS Digital Elevation Models
Town Boundary - NYS Department of Transportation, 1991
Sub-watershed Boundary - EMC GIS Lab delineated and digitized boundaries using USGS topo quads

Flood plains
- A - Areas of 100 year flood; base flood elevations and flood hazard factors not determined.
- B - Areas between limits of 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than 1 foot or where the contributing drainage area is less than 1 square mile; or areas protected by levees from the base flood.

40' Contour
Town Boundary
Sub-watershed Boundary

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Geology, Soils and Groundwater

The structure of soil and bedrock affects the quantity and quality of surface water and groundwater. In this section the surficial and bedrock geology of the Wappinger Creek Watershed is outlined in relation to their capacity for groundwater production.

The bedrock geology of the Wappinger Creek Watershed is primarily based on sedimentary rock, with some metamorphic rock outcrops (Map 5). The sedimentary rocks in the Watershed vary from very hard shales to softer limestones and sandstones. The Wappinger group, an elongated mass of sedimentary carbonate rocks, occurs along the Wappinger Creek for which it was named. The chemical content of the Wappinger group and associated unconsolidated deposits has produced slightly alkaline soils, which are well suited to agriculture.

The lime component also has economic value as crushed stone or agricultural limestone and is mined in the town of Pleasant Valley, near the Wappinger Creek. The Wappinger group is often overlain by thin layers of Balmville limestone and conglomerate, particularly at Rochdale in the town of Poughkeepsie. The Balmville layer is known for its fossils.

Rocks in the Wappinger group weather readily and internal erosion occurs as the movement of groundwater dissolves the carbonate deposits. Solution channels and voids are consequently formed, providing storage cavities for groundwater supplies. This stored water can easily be polluted by contamination sources, such as septic systems, where unconsolidated deposits on top of the carbonate bedrock are not sufficient to filter the waste materials. Wells in the Wappinger group average 22 gallons per minute and the water is hard.

Harder sedimentary rocks including Austin Glen graywacke and shale are found in the towns of Wappinger, Fishkill, and LaGrange, along the uplands between the Wappinger and Sprout creeks, and along an arm extending from Poughkeepsie into the towns of Clinton and Milan. Wells in this formation produce approximately 16 gallons per minute of moderately hard water.

Metamorphic rock outcrops are exhibited most notably at Stissing Mountain, a gneiss outcrop with Poughquag quartzite on the flanks of the mountain. Wells tapping gneiss and quartz formations produce only a small amount of water, averaging 10-11gallons per minute.

The surficial geology of the Watershed is made up of sand, gravel, glacial till and alluvium deposited during the ice age by glaciers (Map 6). Extensive deposits of sand and gravel over limestone along the Wappinger Creek indicate underground reservoirs of water, also known as aquifers (Map 7). Drilled wells in these formations may yield 10-100 gallons per minute of water.

The Groundwater Connection

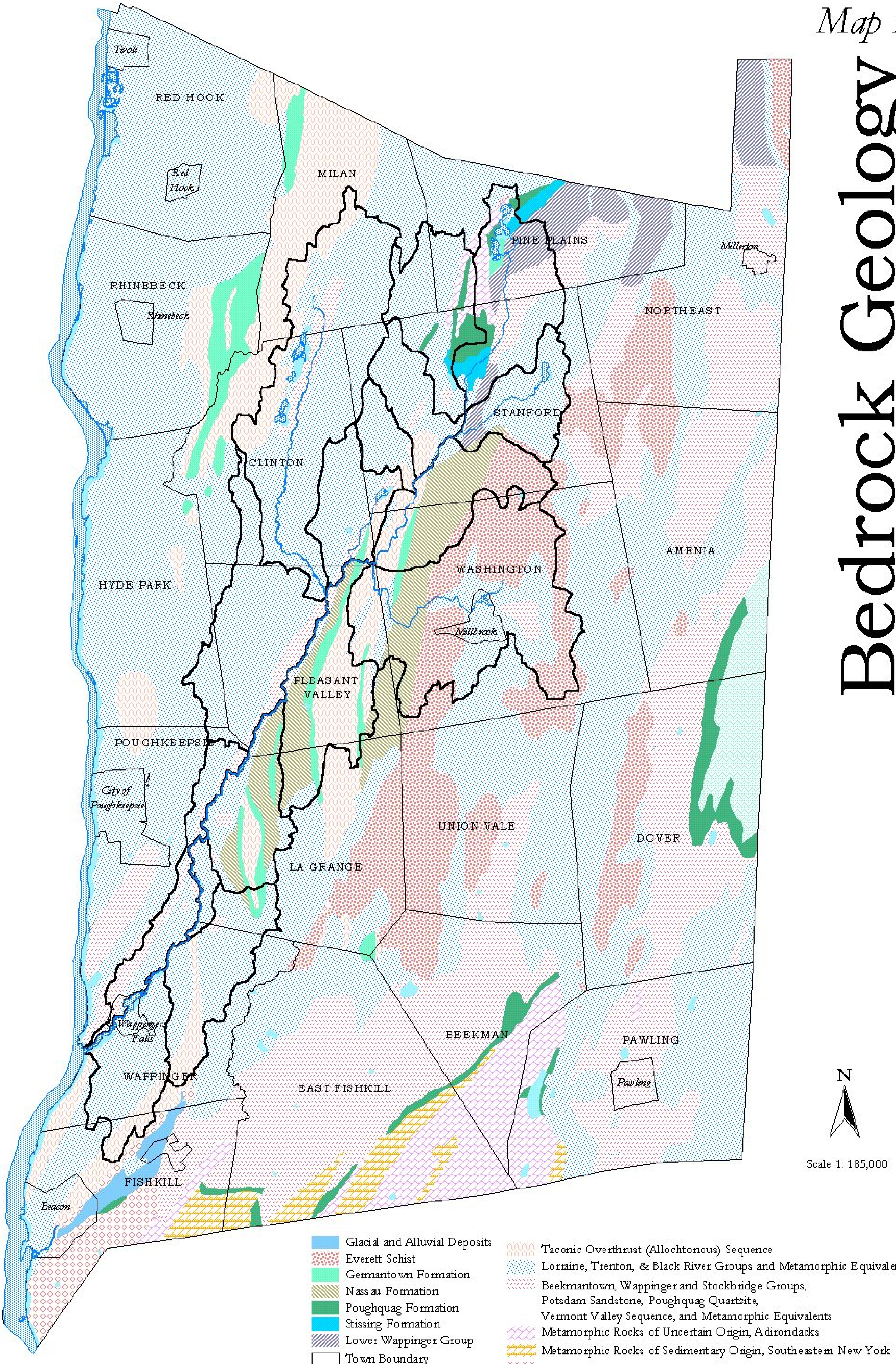
- During dry periods, water in the Wappinger Creek consists solely of groundwater discharging from aquifers in the watershed.
- Under 10-year drought conditions Wappinger Creek flow measured at Wappingers Falls decreases to 4.9 million gallons per day (gpd) (Aquifer discharge during wetter periods is much higher).
- The Watershed above Wappingers Falls contains 181 square miles, or 115,840 acres.
- This means each acre contributes approximately 42 gallons per day during droughts.
- Since the average person consumes 20 or more gallons per day*, wherever population equals 2 persons per acre groundwater no longer reaches the Wappinger Creek during droughts.
- And wherever population exceeds 2 persons per acre, deficit withdrawals are occurring and stream flow is reduced, affecting fish survival, wildlife habitat, swimming, boating, and water quality.

*Consumption is the difference between water entering the home and water returned to nature through septic systems or sewage treatment plants. Per capita water consumption for individuals using septic systems is probably higher than 20 gpd due to evapotranspiration losses off leaching fields.

Provided by Russell Urban-Mead, Hydrogeologist, The Chazen Companies

Map 5

Bedrock Geology



- Glacial and Alluvial Deposits
- Everett Schist
- Germantown Formation
- Nassau Formation
- Poughquag Formation
- Stissing Formation
- Lower Wappinger Group
- Town Boundary
- Subwatershed Boundary
- Water
- Taconic Overthrust (Allochtonous) Sequence
- Lorraine, Trenton, & Black River Groups and Metamorphic Equivalents
- Beekmantown, Wappinger and Stockbridge Groups, Potsdam Sandstone, Poughquag Quartzite, Vermont Valley Sequence, and Metamorphic Equivalents
- Metamorphic Rocks of Uncertain Origin, Adirondacks
- Metamorphic Rocks of Sedimentary Origin, Southeastern New York
- Metamorphic Rocks of Uncertain Origin, Southeastern New York
- Undivided and Mixed Gneisses, Southeastern New York

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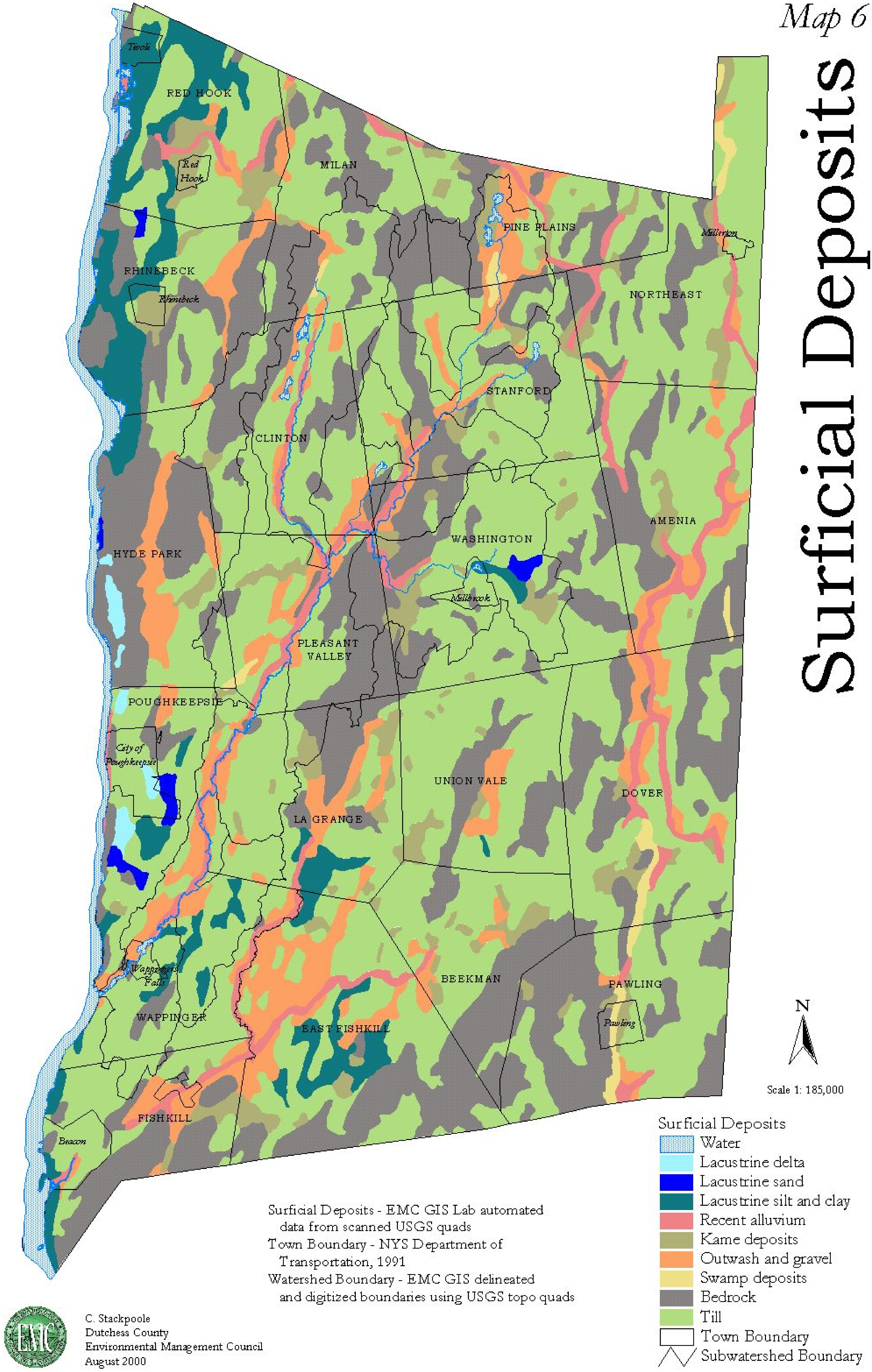
Bedrock Geology - EMC GIS Lab automated data from scanned USGS quads
Town Boundary - NYS Department of Transportation, 1991
Watershed Boundary - EMC GIS delineated and digitized boundaries using USGS topo quads


Map 6
Surficial Deposits
Tivoli
RED HOOK
Red Hook
MILAN
PINE PLAINS
Millerton
RHINEBECK
Rhinebeck
NORTHEAST
STANFORD
CLINTON
AMENIA
WASHINGTON
HYDE PARK
Millbrook
PLEASANT VALLEY
POUGHKEEPSIE
City of Poughkeepsie
UNION VALE
DOVER
LA GRANGE
BEEKMAN
PAWLING
Wappingers Falls
Pawling
WAPPINGER
EAST FISHKILL
FISHKILL
Beacon
N
Scale 1: 185,000
Surficial Deposits
Water
Lacustrine delta
Lacustrine sand
Lacustrine silt and clay
Recent alluvium
Kame deposits
Outwash and gravel
Swamp deposits
Bedrock
Till
Town Boundary
Subwatershed Boundary
Surficial Deposits - EMC GIS Lab automated data from scanned USGS quads
Town Boundary - NYS Department of Transportation, 1991
Watershed Boundary - EMC GIS delineated and digitized boundaries using USGS topo quads
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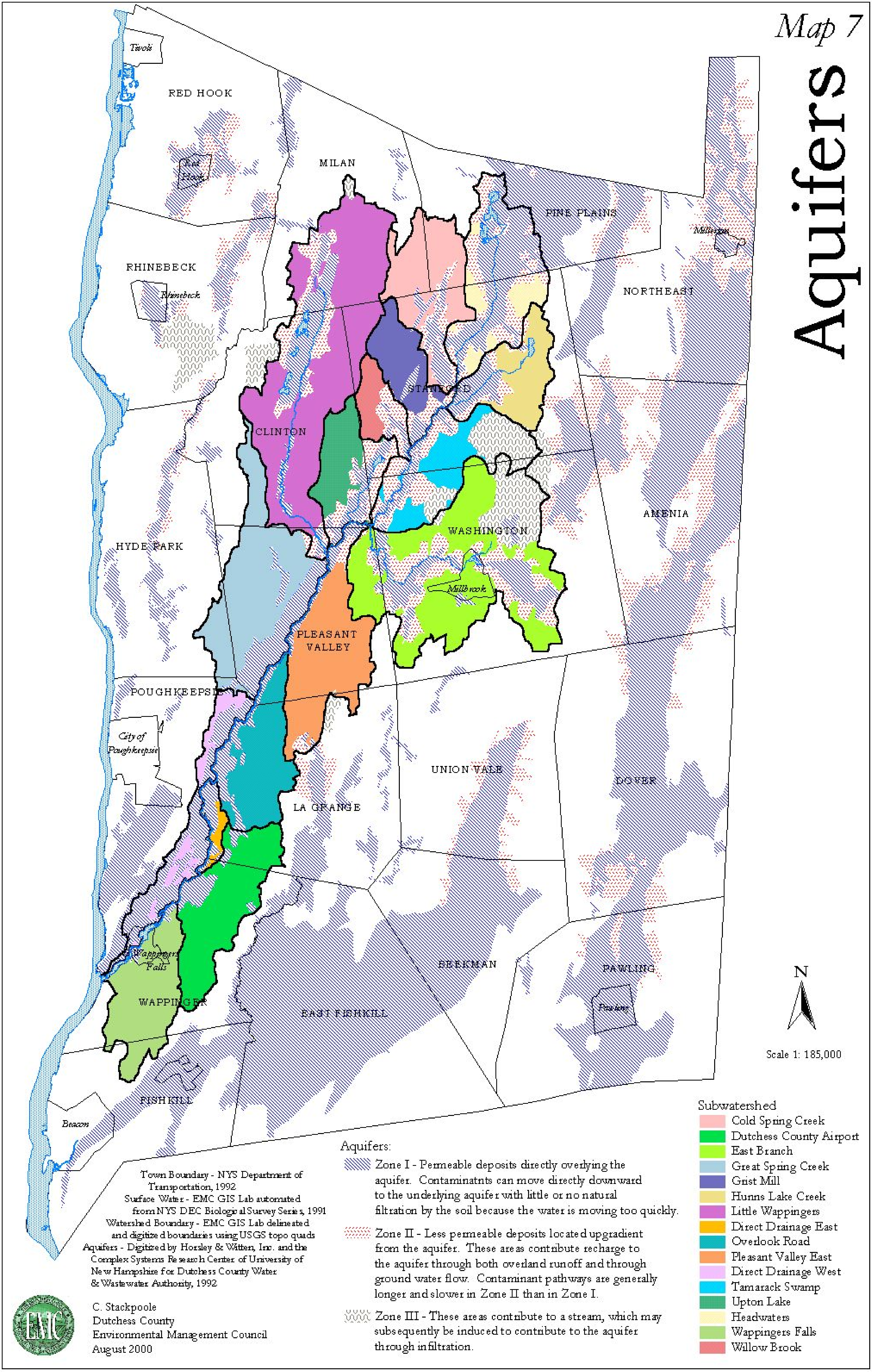
Map 7
Aquifers
Tivoli
RED HOOK
Red Hook
MILAN
PINE PLAINS
Millerton
RHINEBECK
Rhinebeck
NORTHEAST
STANFORD
CLINTON
AMENIA
HYDE PARK
WASHINGTON
Millbrook
PLEASANT VALLEY
POUGHKEEPSIE
City of Poughkeepsie
UNION VALE
DOVER
LA GRANGE
BEEKMAN
PAWLING
Pawling
Wappingers Falls
WAPPINGER
EAST FISHKILL
FISHKILL
Beacon
N
Scale 1: 185,000
Subwatershed
Cold Spring Creek
Dutchess County Airport
East Branch
Great Spring Creek
Grist Mill
Hunns Lake Creek
Little Wappingers
Direct Drainage East
Overlook Road
Pleasant Valley East
Direct Drainage West
Tamarack Swamp
Upton Lake
Headwaters
Wappingers Falls
Willow Brook
Aquifers:
Zone I - Permeable deposits directly overlying the aquifer. Contaminatnts can move directly downward to the underlying aquifer with little or no natural filtration by the soil because the water is moving too quickly.
Zone II - Less permeable deposits located upgradient from the aquifer. These areas contribute recharge to the aquifer through both overland runoff and through ground water flow. Contaminant pathways are generally longer and slower in Zone II than in Zone I.
Zone III - These areas contribute to a stream, which may subsequently be induced to contribute to the aquifer through infiltration.
Town Boundary - NYS Department of Transportation, 1992
Surface Water - EMC GIS Lab automated from NYS DEC Biological Survey Series, 1991
Watershed Boundary - EMC GIS Lab delineated and digitized boundaries using USGS topo quads
Aquifers - Digitized by Horsley & Witten, Inc. and the Complex Systems Research Center of University of New Hampshire for Dutchess County Water & Wastewater Authority, 1992
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Environmental Management Council
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Climate and Acid Rain

The Watershed is located in the north temperate climate zone. Major weather systems that move up the Atlantic Coast or across the continental United States contribute to strong seasonal contrasts and highly variable weather. Ample year-round precipitation is supplemented in late summer by tropical maritime air masses. Polar air masses from Canada move southeast through the area to dominate the winters.

Dutchess County's average annual temperature for the four coldest months, December through March, and four warmest months, June through September, are 30.8 and 70.6 degrees Fahrenheit, respectively. The lowest and highest temperatures ever recorded at the Poughkeepsie weather station were 21 degrees below zero in February 1897 and 107 degrees in July 1966.

The mean date of the first fall frost at Millbrook (the approximate center of the watershed) is September 25, and the mean date of the last spring frost is May 19. Due to the climate-moderating influence of the Hudson River, these dates are approximately 10 days later and 10 days earlier, respectively, for the Wappinger Creek where it enters the Hudson River below Wappingers Falls.

Annual precipitation in Dutchess County normally ranges from 36 to 44 inches. Extremes of 27 and 60 inches have been recorded. While Dutchess County enjoys abundant rainfall, the acidity of the rainfall has become a serious pollution problem. Due to the combustion of fossil fuels in the Ohio valley, the pH of rainwater in Dutchess County averages 4.2, compared to a United States average of 5.6 (rainfall pH data from the Institute of Ecosystem Studies). Fortunately, soils and bedrock that are rich in lime can help buffer the effects of acid rain on surface waters and soils. High lime concentrations are characteristic of the Watershed. However, the length of time that lime can be counted on to shield such areas from the effects of acid rain is unknown. Some scientists believe that the buffering capacity of many areas may be nearly exhausted.

Wildlife & Fisheries

Animal populations are sensitive indicators of environmental health, often responding to subtle changes in pollution levels, land uses, and other stresses in observable ways. Animals that need large, continuous, or interconnected habitat units often have trouble maintaining populations as their habitats become increasingly fragmented by land use changes.

Beaver and pileated woodpecker disappeared at one time due to habitat fragmentation but have now returned. Some species, such as the bobcat, mink, otter, and Atlantic sturgeon, are less common now then they were in the 1600's, while other species, such as deer, raccoon, red fox, robin and painted turtle are more common today. Osprey, eagles, and several species of hawks have made a remarkable comeback after suffering reproductive failure from the 1940's to 1970's due to the pesticide DDT. Several species are relative newcomers to the watershed. Coyotes moved into Dutchess County about 20 years ago and are now permanent residents. The Canada goose, now a moderately common breeder, was formerly only a migrant in the county.

Cold-water fish including brook trout and sculpin have had some of their habitats ruined by the removal of bank vegetation and the silting and warming of streams. Small populations of these species are still present in localized areas in the northern half of the Wappinger Creek and in some tributaries. The habitats of cattail-nesting birds, such as the marsh wren, are reduced as purple loosestrife replaces cattails in disturbed marshes. Introduced starlings have displaced eastern bluebirds from natural nesting cavities. Rattlesnakes have declined in range and number as a result of commercial collection, wanton killing and destruction of habitat.

Deer, eastern cottontail, and gray squirrel are important game animals in the watershed. Muskrat, beaver, red fox, and gray fox are valuable furbearers. Game birds include ruffed grouse, ring-necked pheasant, wild turkey, and a number of waterfowl species.

The lakes in the watershed, especially Wappingers Lake and Thompson Pond, are attractive to migrating waterbirds. Birds likely to be observed around the lakes include gulls, geese, ducks and shorebirds. An Iceland gull and old squaw ducks have been sighted on Wappingers Lake in the past. The tidal Wappinger Creek supports mute swans, migrating Canada geese, mallards, black ducks, wood ducks, green heron, kingfishers and osprey. There is a small Great Blue Heron rookery recorded by the Natural Heritage Program in the northern part of the watershed.

Wappinger Creek resident fishery species include chain pickerel, redbreast sunfish, pumpkinseed, bluegill, and black crappie. The American eel is also present during its juvenile life stage. The Wappinger Creek Estuary seasonally resident fishery species include alewife, blueback herring, white perch, striped bass, carp, golden shiner, white sucker, white catfish, small mouth bass, large mouth bass, and yellow perch.[*] Eel and striped bass are still off-limits for commercial fishing because of their high PCB content.

Wappingers Lake supports a variety of warm water fish, including American eel, largemouth bass, smallmouth bass, rock bass, brown bullheads (catfish), carp, yellow perch, black crappies, common shiners, bluegill shiners, golden shiners, white suckers, pumpkinseed sunfish and redbreast sunfish. Other lakes in the watershed also support many of these fish species.

The New York Natural Heritage Program lists 14 rare or endangered animals in the watershed, located throughout the watershed from Pine Plains to Wappingers Falls. In particular, the Blanding's Turtle (threatened in New York State) has been sighted in wetlands in Clinton, Hyde Park and LaGrange and may be breeding in some of these wetlands. The exact locations of rare and endangered species are not released to prevent collection.

Amphibians are especially important as indicators of watershed health, since a healthy number and diversity of amphibian species indicates a healthy watershed. Declining amphibian numbers often indicates loss of wetlands and the accompanying loss of wetland functions and values for water resource management. In addition to the Blanding's turtle, some of the other amphibians and reptiles that can be found in the watershed include the painted turtle, spotted turtle, wood turtle, ribbon snake, garter snake, water snake, newt, dusky salamander, spring peeper, bull frog, green frog, pickerel frog, and wood frog.

Demographics

The population of the municipalities in the watershed (1990 Census) ranges from 1,895 in the Town of Milan to 26,008 in the Town of Wappinger. The Dutchess County Department of Planning has available the results of a Forecasting Project for growth during the years 1880-2020. The average annual growth for the years 1995-2020 is projected to be 19.8% for the County, with large increases expected in the Town of Fishkill (32%), Town of Pleasant Valley (24%), Milan (25%), and Washington (20%). (Map 8)

These figures are important because they indicate the projected increase in demand for water throughout the watershed. Each municipality should base land use decisions on available water, including budgeting for future growth. The figures also will translate into impacts on open space, recreation, and an increase in nonpoint source pollution in our surface water.

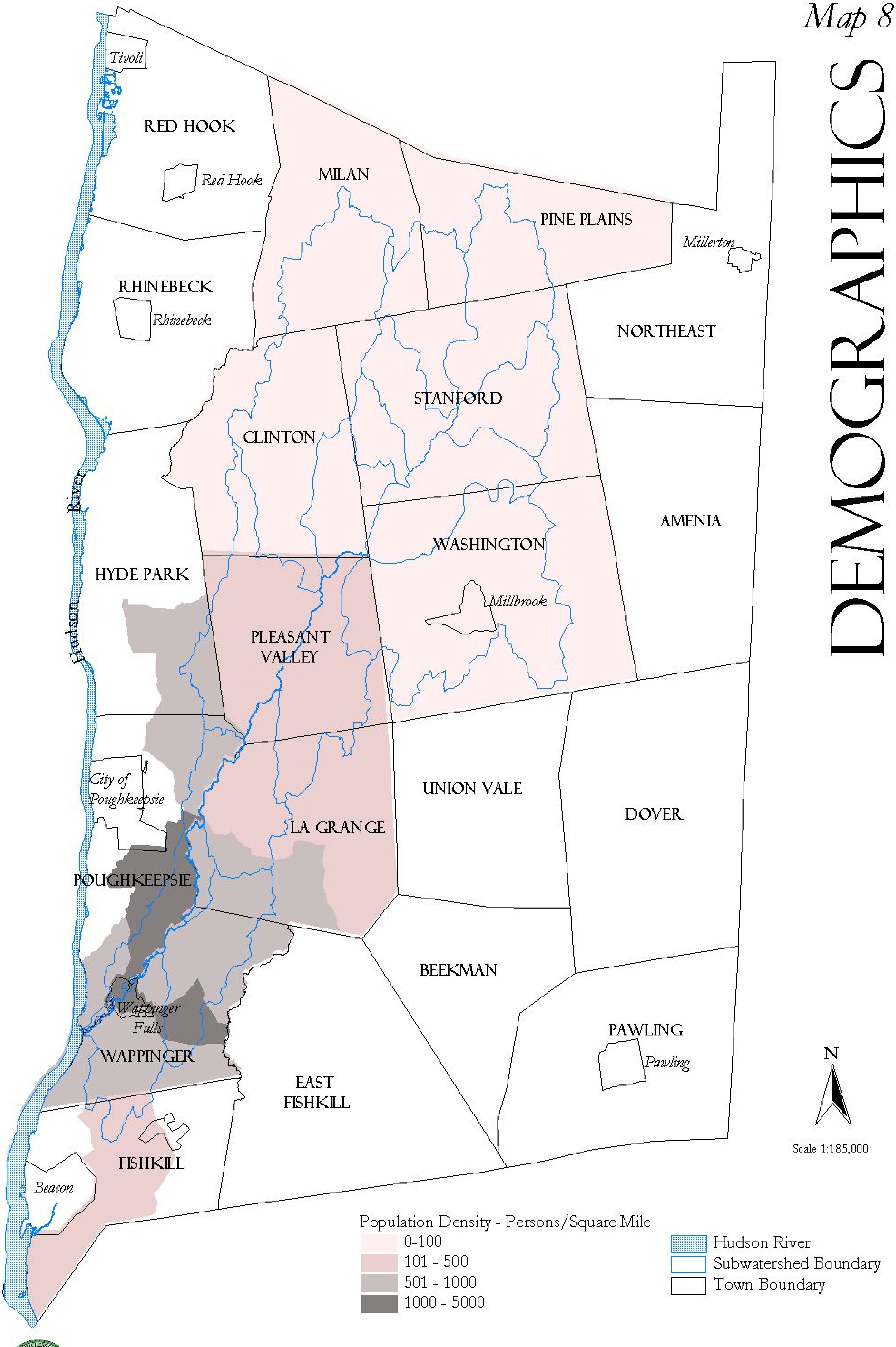
Recreation

The Wappinger Creek Watershed is used extensively for recreation, as studied by the

[*] Fish information relevant to the Wappinger Creek provided by Tom Lake.

Map 8

DEMOGRAPHICS



EMC

C. Stackpoole
Dutchess County
Environmental Management Council
August 2000

Demographics - Dutchess County Department of Planning and Development, 1990
Watershed Boundary - EMC GIS Lab delineated and digitized boundaries using USGS topo quads
UTM Boundary - NYS Department of Transportation, 1992

Marist College Bureau of Economic Research in 1998[10] through a survey of recreational users. The typical user engages in outdoor activities frequently, lives within 5 miles of the Wappinger Creek, and has been using the watershed for more than ten years for activities such as fishing, hiking, picnicking and boating. Over $1.2 million annually is spent in direct and indirect expenditures related to the recreational use in the watershed, including lodging, food, travel expenses, equipment and supplies, site fees and licenses.

According to the survey, nearly two-thirds of the recreational users felt that the presence of open space along the creek is very important to the recreational experience, 30% indicated that open space was somewhat important, and only 11% indicated that open space was not important to them for recreational activities. To explore this further, recreational users were asked to indicate the maximum amount of money they would be willing to contribute to pay for a hypothetical 2,000 acres of woods and fields near Wappinger Creek to preserve as open space. 85% responded that they would be willing to pay an average of $17.61 per year in order to purchase and preserve the 2,000 acres.

Agriculture: Wappinger Watershed is Pilot for New York State Initiative

Agriculture is the third largest private industry in Dutchess County, generating between $100 and $200 million per year and employing about 1500 full-time employees. Dutchess County farmers have a long and proud history of conserving our County's natural resources: our soil, water, air, and wildlife. Farmers have rotated crops, installed stripcropping on sloping fields, and effectively used manure as a fertilizer resource on the farm, instead of disposing of it as a waste.

However, times have changed in the countryside. Where once neighbors were farmers or someone related to a farmer, it's now quite likely they are newly arrived from the city or the suburbs – perhaps with no background or understanding of the realities of agriculture. State and federal legislation contains provisions that affect the way farmers must farm. Longstanding state and federal conservation programs have new names and new ways of doing things. Because of all these changes, farmers have asked for a coordinated, science-based and "farmer-friendly" way of addressing environmental concerns associated with their operations.

The Agricultural Environmental Management initiative—or AEM for short—has been developed cooperatively by farmers and a partnership of state, federal and local natural resource agencies and organizations. AEM integrates environmental protection and improvement with the needs of farmers and communities, while linking existing agricultural service agencies together and to the farmer as a team. AEM is a voluntary, common sense, cost-effective, and science-based approach to planning and implementing environmental protection measures. It targets existing technical assistance and financial support to farms with the greatest potential for environmental problems. In short, the goal of AEM is to help farmers protect the environment, while maintaining the health and vitality of their farm operations. To date, over 100 farms in the Wappinger Creek Watershed have participated in the AEM program.

The "Tiered" Approach to Agricultural Environmental Management

The essence of AEM is a five-"tiered" planning process. Throughout, core members of the local working group – "the County Project Team" – work with the farmer to carry out the tiered approach. Qualified private consultants may also be used at appropriate points in the process. The AEM tiered approach takes place on the farm, with the farmer as the decision-maker.

The five tiers used in AEM are as follows:

- Tier 1: A questionnaire designed to collect information about the farm and farm practices is completed by the farmer.
- Tier 2: Worksheets that assess the farm's impact and potential impact on the environment are completed by the farmer based

on answers to the questionnaire completed in Tier 1 and the farmer's business objectives.

- Tier 3A: A plan is developed to provide solutions to specific environmental problems and concerns identified in Tiers 1 and 2. The plan is used when solutions will not seriously affect the viability of the farm operation.
- Tier 3B: A "Whole Farm Plan" is developed which coordinates farm business objectives with environmental protection. This approach is used when implementing comprehensive environmental solutions that may have a substantial effect on farm viability.
- Tier 4: Plans developed in either Tier 3A or 3B are implemented, often through the use of "Best Management Practices" (measures that prevent or reduce nonpoint source water pollution). Tier 4 may involve engineering and construction measures, or changes in farm practices and methods. The County Project Team helps the farmer access and coordinate local, state and federal cost-sharing and incentive programs to help in carrying out environmental protection measures.
- Tier 5: Evaluations are carried out, both of the local AEM initiative as a whole and environmental outcomes on individual farms. This includes measuring both participation in and effectiveness of the AEM initiative at the individual farm level and at the larger area or watershed level.

The underlying concept of the tiered approach is to target human and financial resources to farms with the greatest potential for impacting the environment. After completing Tier 2, many farmers will discover they have minimal environmental concerns, and these can be addressed without a Tier 3 plan. That frees up technical and financial assistance for farmers who find they do have environmental concerns and/or problems, and need to progress through Tier 3 and beyond. The planning process is continuous and flexible. The evaluation phase provides an opportunity to address changes in the farmer's objectives, additional environmental concerns that may need attention, and other changes necessitated by the constantly changing nature of agriculture.

Land Use Regulations and Zoning

An inventory of the land use regulations in the thirteen watershed municipalities was compiled by the Land Use Law Center at Pace University School of Law in fall of 1999 and spring of 2000[11]. The results of this inventory are termed the "Watershed Analysis", which is a compilation of rules and regulations relating to watershed management (i.e. zoning, subdivision and site plan ordinances, wetland regulations, historic preservation ordinances, etc.). The Watershed Analysis was created using the Watershed Template, which is part of a larger system created by the Land Use Law Center called the Land Use Regulation Diagnostic System. The purpose of the Diagnostic System is to create a useable summary of all of the local land use regulations in a particular municipality and to assist local leaders in analyzing those regulations in different ways. For an in-depth explanation of the Diagnostic System see Appendix 8.

A preliminary analysis of zoning ordinances in the watershed by the Land Use Law Center research associate shows that the southern-most communities have enacted the most comprehensive ordinances. The zoning ordinances are less and less comprehensive as one moves north, until Pine Plains, where there is no zoning at all.

The results of this inventory have been compiled into a "Land Use Regulation Comparison Chart" located in Appendix 8. This chart is a brief comparison of selected topics covered by the Digest, and was created using the Digests of each of the thirteen municipalities. An example of the watershed template for the Town of Clinton is also included in Appendix 8.

The complete diagnosis and watershed template for each municipality in the Wappinger Creek Watershed can be obtained from the Dutchess County Environmental Management Council office in Millbrook. Electronic copies of all of the documents are also available.

III. Water Quality in the Wappinger Creek Watershed

Introduction

Several studies over the past forty years have highlighted the problems with Wappingers Lake and have suggested a watershed approach for control of nutrient and sediment inputs via nonpoint source pollution (see the glossary for a definition of point and nonpoint source pollution). As early as 1955, the "Community Soil and Water Conservation Report for Wappinger Creek Watershed"[12] concluded that, "Detailed investigations will be necessary for the formulation of a watershed program." In the early 1980's, "The Lower Wappinger, a Significant Area"[13] provided fourteen recommendations including water quality monitoring of tributaries, review of State Pollution Elimination Discharge System (SPDES) permits, and development of a watershed management plan. A reconnaissance study under the Clean Lakes Program completed by the US Army Corps of Engineers in 1993[14] recommended both short- and long-term solutions to the eutrophication problems (see glossary) in Wappingers Lake, including sediment and nutrient reduction and a watershed-wide management plan. At the same time, studies throughout New York State have shown that nonpoint source pollutants account for 93% of river impairment and 86% of lake impairment (NYSDEC Division of Water, 1996).

To address these recommendations the Wappinger Creek Watershed Planning Committee Stream Monitoring Subcommittee decided that a watershed-wide water quality monitoring study was necessary. First, the committee reviewed water quality data that had been collected in the past. The NYSDEC collects data through the Rotating Intensive Basin Study (RIBS) program every five years. On the Wappinger Creek this includes collection of benthic macroinvertebrates (see glossary) at Jackson Road in Poughkeepsie (last collection done in 1998). The United States Geological Survey (USGS) collects water quality data at the Red Oaks Mill stream gauging station in the Town of LaGrange[*] and has historical data from the County Route 13 stream gauging station which is no longer in service. However, these data are confined to the main stem of the Wappinger Creek and are limited in scope.

Based on the review of the past and present studies, the committee recommended that to target areas for nonpoint source pollution reduction and management in the Watershed it was necessary to complete a more in-depth water quality study. Therefore, a three-phase water quality study was designed and conducted from summer 1997 to spring 2000. The first phase consisted of a baseline water quality monitoring study of the main stem of the Wappinger Creek. The second phase involved monitoring of the major tributaries to the Wappinger Creek. The third phase was a targeted study of wetlands in the watershed to determine their capacity to filter nonpoint source pollution in three different land use areas.

In addition to the water quality studies an on-going biological monitoring study has also been initiated in the watershed. Volunteer involvement has contributed to the success of this program, which consists of spring and fall collection of benthic macroinvertebrates.

The results of these studies are summarized in this section of the Watershed Management Plan. For detailed water quality data information and an in-depth report on the wetland comparison study[15], please contact the EMC offices in Millbrook, New York at (914) 677-5253.

Wappinger Creek Watershed Stream Monitoring Study

INTRODUCTION

The Wappinger Creek Watershed Stream Monitoring Study was designed to identify the levels of nutrients (nitrate and phosphate), fecal coliform bacteria, and suspended material

[*] For daily flow values at Red Oaks Mill, go to the USGS website: www.usgs.gov and search for stream gauging station #01372500.

(including sediment) present in the Wappinger Creek watershed. To provide background on these water quality parameters, a short summary of each is given below, and an explanation of various terms can be found in the glossary. The results of the study can be found on pages 33-36.

Nutrients: Nitrogen

Nitrate is the form of nitrogen that is an essential nutrient for plant growth. The majority of nitrogen is in the form of a gas (N_2), which makes up approximately 80% of our air. Most plants cannot use N_2, but some types of terrestrial plants, nitrogen-fixing bacteria, lightning and natural nitrification in the water and soil can convert the different forms of nitrogen into nitrate (NO_3). NO_3 is the form of nitrogen essential to plant life, but is also a good indicator of sewage or fertilizer in the water. Nitrate, the most mobile form of nitrogen, can either be absorbed by vegetation, leach into groundwater or surface water, or be converted to nitrogen gas in the process of denitrification[16].

Nitrates in excess amounts can accelerate eutrophication of surface waters. Natural levels of nitrates tend to be low (less than 1 mg/L) as opposed to sewage treatment plant effluent where they can range up to 30 mg/L[17]. However, due to present and past land uses the natural level (below 1 mg/L) of NO_3 rarely exists in Dutchess County today. Indeed, only one of the subwatersheds in the Wappinger Creek basin exhibited levels below the recommended natural level of 1.0 mg/L throughout the duration of the study. To provide a basis for recommending management practices, the EMC water quality study developed a threshold value of 1.8 mg/L based on the median concentrations of nitrate present in the watershed in 1999. The subwatersheds that were in the 67th percentile, or top 1/3, should be targeted first for implementation of best management practices.

Nitrates can also present a human health concern in drinking water. Any water that contains nitrate concentrations of 44 mg/L nitrate (equivalent to 10 mg/L nitrate-nitrogen for EPA and NYSDOH standards) or higher has the potential to cause blood poisoning and hypertension in infants, gastric cancers in adults, and fetal malformations if consumed. Although the much higher human health standard for nitrate consumption has no correlation with stream health, high levels of nitrate in both surface and groundwater usually indicates widespread nonpoint source pollution.

Nutrients: Phosphorus

Phosphorous is also a nutrient essential to plant growth. In aquatic ecosystems phosphorus occurs mainly in the form of organic and inorganic phosphate. Organic phosphate is bound in plant and animal tissue and is unavailable for plant uptake. Inorganic phosphate (orthophosphate) is in a form that is available and needed by plants. Plants absorb orthophosphate from the surrounding water and convert it to organic phosphate. In freshwater ecosystems phosphate tends to be the nutrient that is least available for plant growth. Consequently, phosphate is the limiting factor, and small additions to surface waters can result in large amounts of plant growth and eutrophication.

Phosphate tends to bind to soil particles, which slows its transport. However, phosphate can be resuspended during stream bottom disturbances, or added by stream bank erosion. The most likely sources of phosphate inputs include animal wastes, human wastes, fertilizer, detergents, disturbed land, road salts (anticaking agent), and stormwater runoff. In general, any concentration over .05 mg/L of phosphate will likely have an impact on surface waters[18]. However, in many streams and lakes concentrations of PO_4 as low as .01 mg/L can have a significant impact.

To provide guidance for recommending management strategies, the EMC water quality staff developed a threshold value of .047 mg/L based on the median concentrations of orthophosphate present in the watershed in 1999. As recommended for nitrates, the subwatersheds that were in the 67th percentile, or top 1/3, should be targeted first for implementation of best management practices.

Suspended Solids

Suspended material (solids) includes silt and clay particles, plankton, algae, fine organic debris, and other particulate matter. These are particles that will not pass through a 2-micron filter. Suspended solids can serve as transport for toxic chemicals, phosphate, and fecal coliform bacteria. A high concentration of solids may also decrease water clarity leading to a slowing of photosynthesis by aquatic plants. Additionally, water will heat up more rapidly and hold more heat. As a result aquatic life that relies on cold water will suffer. Finally, the excess sediment will degrade in-stream habitats by covering the stream bottom, smother aquatic insects and fish eggs, and possibly adversely affect dissolved oxygen levels in the waterbody.

Sources of suspended solids include industrial discharges, sewage, fertilizers, road runoff, and soil erosion. There is no standard for natural limits of suspended materials due to the variability of different aquatic ecosystems. To provide a basis for recommending management practices, the EMC water quality study developed a threshold value of 4.34 mg/L based on the median concentrations of suspended material present in the watershed in 1999. The subwatersheds that were in the 67th percentile, or top 1/3, should be targeted first for implementation of best management practices.

Fecal Coliform Bacteria

The final parameter analyzed during the stream study was fecal coliform bacteria. Fecal coliform bacteria are used as an indicator of possible sewage contamination because they are commonly found in human and animal feces. Although the coliform bacteria are generally not harmful themselves, they indicate the possible presence of pathogenic bacteria, viruses, and protozoa that also live in the human digestive tract. Therefore, the greater the number of fecal coliform bacteria colonies present the greater the human health risk for other pathogens. In addition to the human health risk, excess fecal coliform bacteria can cause increased oxygen demand, cloudy water, and unpleasant odors. Common sources of fecal coliform bacteria in waterways include sewage treatment plants, on-site septic systems, domestic and wild animal manure, and storm water runoff.

Testing for all bacteria, viruses and protozoa is very costly and time consuming. Therefore it is common practice to test for fecal coliform bacteria as an indicator of pathogens. The New York State Department of Health standard for contact recreation (swimming) is as follows: the fecal coliform bacteria density should not exceed 200 colonies per 100 ml, based on a logarithmic mean from a series of five or more samples over a thirty-day period.

This water quality study was designed to not only look at human health concerns, but also to analyze the biologic health of the watershed. Therefore, as well as the New York State Department of Health threshold EMC water quality study also developed a comparative threshold value of 600 colonies per 100 ml based on the median concentrations of fecal coliform bacteria present in the watershed in 1999. The subwatersheds that were in the 67th percentile, or top 1/3, have exceedingly high levels of fecal coliform bacteria and should be targeted first to reduce inputs of fecal coliform bacteria to the watershed.

The Wappinger Creek watershed study also included an analysis of baseline chemistry, consisting of measurements of dissolved oxygen, pH, turbidity, hardness, alkalinity, and conductivity. The importance of these parameters is explained briefly here.

Dissolved oxygen is naturally consumed and produced in aquatic systems, and is necessary for almost all aquatic organisms. If dissolved oxygen levels fall below a certain threshold biologic integrity will be compromised. For example, a level of 7 mg/L to 11 mg/L is very good for most stream fish[19]. Another way of analyzing the dissolved oxygen is to look at percent saturation. Percent saturation is the amount of oxygen in a liter of water relative to the total amount of oxygen the water can hold at a given temperature. A percent saturation of

60% to 79% is acceptable for most stream animals[20].

The EMC also tested the water pH and alkalinity (see glossary). pH is important because most species of aquatic organisms prefer a pH in the range of 6.5 to 8.0. Due to the acidity of rainfall, maintaining this level is of concern in New York State. However, calcium carbonate raises the alkalinity and hardness of the water, and provides a buffer for acidic inputs. Testing the hardness of the water allowed us to determine the presence of calcium carbonate in the watershed.

Turbidity and conductivity were also measured in the Wappinger watershed in 1999. The turbidity of the water is a measure of how the particles suspended in the water column affect the water's clarity. An estimate of the suspended material present in the water can be made based on turbidity. Conductivity is the measure of the ability of water to carry an electric current, and is determined primarily by geology. High conductivity is created by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions or sodium, magnesium, calcium, iron, and aluminum cations. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a conductivity range of 150 to 500 μmhos/cm[21]. The EMC used the 500 μmhos/cm as the threshold for river impairment.

METHODS

Water samples from twelve major tributaries of the Wappinger Creek (Table 7, Map 3) were collected twelve times from January 1999 through December 1999. Samples were collected in a variety of flow conditions, consisting of seven samples at base flow

Table 7. Stream Monitoring Sites (Located on Map 3)

Sample Site	Distance of tributary in miles from the confluence of the Wappingers Creek and Hudson River	Distance of sampling site in miles from the confluence of the tributary and the Wappingers Creek
Mountain Road	Wapp 33.85	NA
Cold Spring Creek	Wapp 31.42	CS 1.27
Hunns Lake Creek	Wapp 30.63	HL .34
Tamarack Creek	Wapp 29.83	Tam .02
Creamery Road	Wapp 29.85	NA
Grist Mill Creek	Wapp 28.39	GM .02
Willow Brook	Wapp 28.16	WB .02
Jameson Hill Road	Wapp 27.2	NA
East Branch WC	Wapp 24.36	EB .08
County Route 13	Wapp 24.04	NA
Upton Lake Creek	Wapp 23.43	UL .38
Little Wappingers Creek	Wapp 21.61	LW .06
Hurley Road	Wapp 20.88	NA
Great Spring Creek	Wapp 17.75	GS .40
Pleasant Valley East	Wapp 17.16	PVE ,08
Pleasant Valley	Wapp 16.56	NA
DeGarmo Road	Wapp 12.28	NA
Old Manchester Bridge	Wapp 10.98	NA
Red Oaks Mill	Wapp 8.01	NA
Dutchess County Airport	Wapp 4.67	DCA .29
Quiet Acres	Wapp 4.46	NA
Industrial Park	Wapp 1.94	NA

conditions and five samples during storm conditions. Flow conditions were identified using discharge data from the United States Geological Survey (USGS) stream gauging station[22] at Red Oaks Mill, NY.

Project staff followed USEPA-approved quality assurance/quality control measures throughout the sampling and analysis process[23]. Collection bottles were washed prior to sampling. Two 60-ml polyethylene bottles per site were washed with 10% hydrochloric acid. One 1000-ml polyethylene bottle per site was washed with distilled water. All bottles were rinsed three times with stream water immediately preceding collection.

Grab samples were collected in two 60-ml and one 1000-ml polyethylene bottle at each site. Each bottle was submerged in the mainstream current at the middle of the water column. Temperature was measured in the field.

Discharge was measured at each site according to protocol designed by Harrelson et al[24]. Two models of flow meters were used, the Global Flow Probe FP201 with a meter stick for determining stream depth and Swoffer Instruments 2100 with a depth-setting wading rod. All velocity measurements were taken at approximately six tenths of stream depth.

Samples were analyzed according to American Public Health Association protocols in *Standard Methods for the Examination of Water and Wastewater*[25]. Following collection, two 60-ml samples were filtered to remove large (>0.45 microns) organic debris and acidified to approximately pH of 2.0. Samples were analyzed for nitrate, using the cadmium reduction method, and phosphate, using the ascorbic acid reduction method. Fecal coliform bacteria colonies per 100mL were determined through the membrane filtration method. Total suspended material was measured by drying to 103-105° C. In addition, two sample sets, taken in January and March, were analyzed for the following baseline chemistry variables: dissolved oxygen, pH, alkalinity, hardness, turbidity, and conductivity. Data analysis was performed in Microsoft Excel by stream monitoring staff.

RESULTS AND DISCUSSION

The baseline chemistry, nutrient, suspended material, and fecal coliform bacteria data collected in this study provide an excellent means of analyzing future trends of water quality in the Wappinger Creek watershed. The data show that nitrate and phosphate levels in the subwatershed tributaries were fairly high throughout the watershed (Figures 2 and 3). Most likely, the nutrient concentrations can be attributed to the rapid groundwater transport of local septic system effluent, residential fertilizer applications, atmospheric deposition and agricultural operations. The eutrophication of watershed lakes and ponds is a symptom of the elevated nutrients entering the watershed. An additional symptom of pollution is the increasing number of drinking water wells in the watershed contaminated with nitrate and bacteria (Appendix 3).

Suspended material transport in the subwatersheds varied greatly (Figure 4). This variability made it difficult to draw conclusions based on subwatershed land use. However, it is evident that a number of the subwatershed streams consistently produced median suspended material levels that exceeded the criteria developed by the EMC (See Figure 4 and descriptions for each subwatershed in the next section).

One of the primary objectives of this Management Plan is to identify the sources of nutrients and sediment to Wappingers Lake and to recommend management strategies to reverse the trend. Based on the tributary monitoring data, the following subwatersheds should be targeted first for implementation of best management practices to reduce sediment and nutrient loading to the watershed. In conjunction with this initial step, proper best management techniques should also be employed in the other subwatersheds.

The East Branch subwatershed had the second highest median suspended sediment concentrations in 1999 and contributed the most flow to the Wappinger Creek (Figure 4 and Figure 5). Therefore, the East Branch contributed the most sediment load to the Wappinger Creek when compared to the other major tributaries. Other subwatersheds that contributed a significant amount of suspended sediment to the Wappingers Creek included: Pleasant Valley East, Wappinger Creek Headwaters, Great Spring Creek, Dutchess County Airport, and Little Wappingers.

Nutrient (nitrate and phosphate) inputs varied among the subwatersheds, but it is clear that the Pleasant Valley East subwatershed contributed the highest concentration of phosphate to the Wappinger Creek (Figure 3). Wappinger Creek Headwaters, Willow Brook, East Branch and Great Spring Creek also showed concentrations of phosphate at or above levels that are likely to impact the ecological balance of the stream and lake. Although the Willow Brook Subwatershed contributed the smallest amount of flow to the Wappinger Creek of all the major tributaries, it contained the highest concentration of nitrates, almost 10 times the concentrations of Cold Spring Creek (Figure 2). Other contributors of high nitrate concentrations were Hunns Lake Creek, Upton Lake Creek, Great Spring Creek and the Dutchess County Airport tributary.

As well as the impact of nutrient and sediment loading from subwatershed tributaries, inputs directly to the main stem of the Wappinger Creek are also occurring. To analyze these impacts further, the analysis of streambank erosion along the main stem of Wappinger Creek, initiated in summer of 2000, should be continued in order to target areas for remediation. Also, a cumulative impact analysis of SPDES discharge sites along the Wappinger Creek and into Wappingers Lake should be done including total loading of nutrients. Based on the results of the cumulative impact study, the Watershed Planning Team should work with the NYSDEC to reduce these inputs.

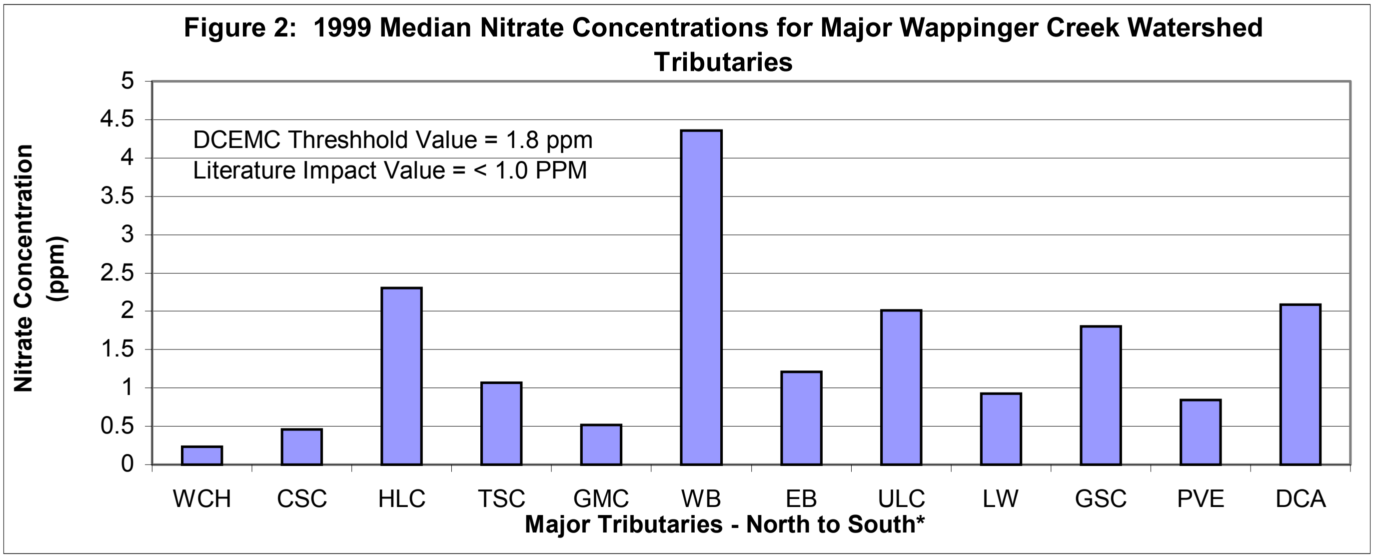
One of the more troubling findings was the amount of fecal coliform bacteria present in the subwatersheds (Figure 6). These high levels of fecal coliform bacteria were probably discharged from poorly planned septic system drain fields and/or agricultural operations.

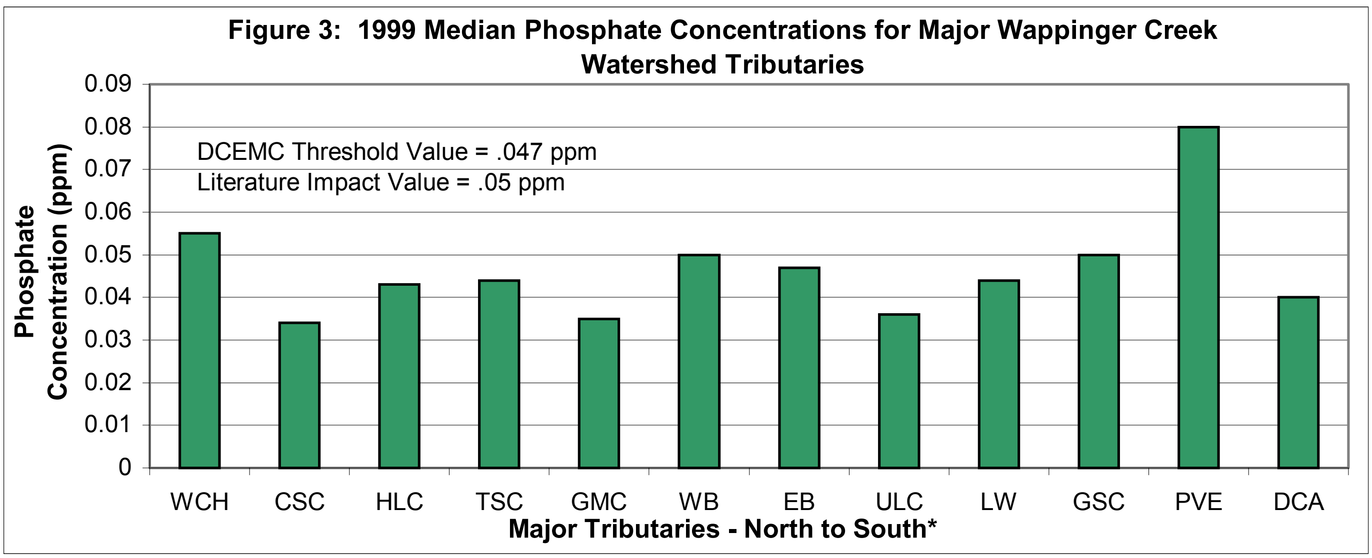
Dissolved oxygen (DO) concentrations and percent saturation levels of oxygen tended to be healthy in the watershed. However, the Wappinger Creek Headwaters consistently contained poor DO levels. In late summer and early fall DO levels approached levels that would stress cold water fisheries. As documented in Wappinger watershed wetland report, the low DO levels could be attributed to decomposition of organic matter from the upstream wetland and poor barnyard management[26].

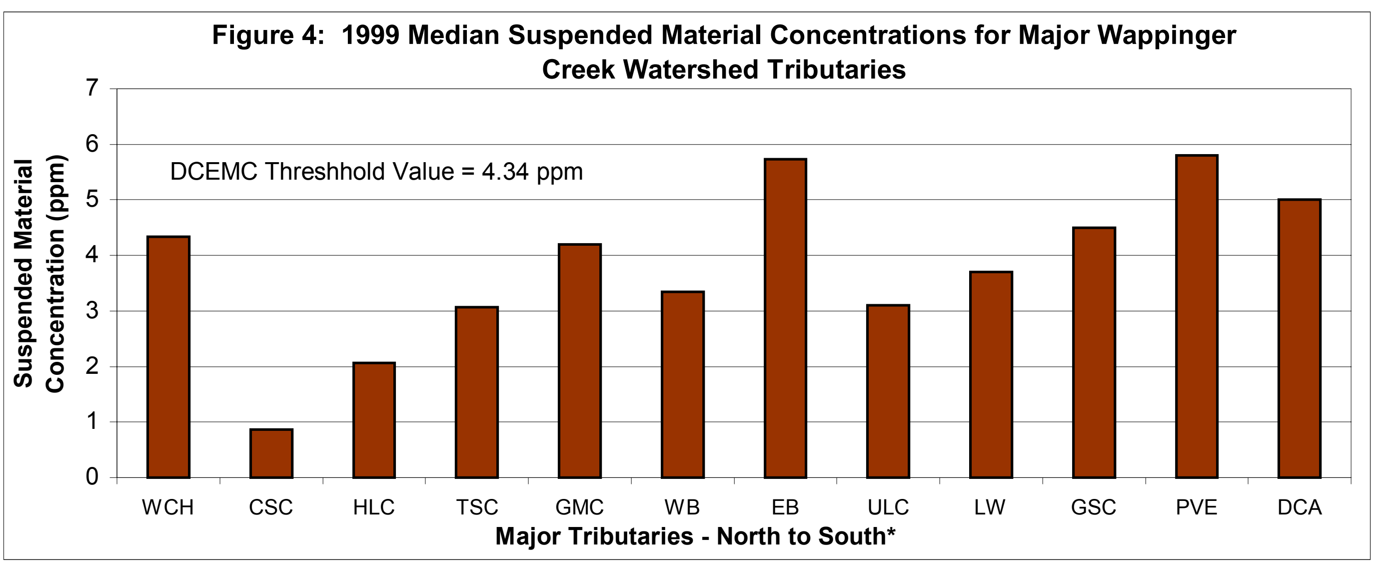
The pH of the watershed was typically around the neutral level of seven. Alkalinity levels were relatively high, with the highest levels during baseflow events, and lowest levels during higher flow regimes. This variability was due to the acidic nature of rainwater in the northeast and storm water runoff, which were buffered at low water levels by the vast amount of dolomitic limestone present in the watershed.

Conductivity in the watershed was on the upper end according to criteria developed for inland fisheries of the United States[27]. The Dutchess County Airport and Great Spring Creek conductivity levels were over the 500 μmhos/cm threshold in 1999, which may be an indicator of inorganic dissolved solids from nonpoint source pollution such as chloride, nitrate, sulfate, and phosphate. The remainder of the concentrations at the EMC sampling sites fell below the threshold, but tended to be on the upper end.

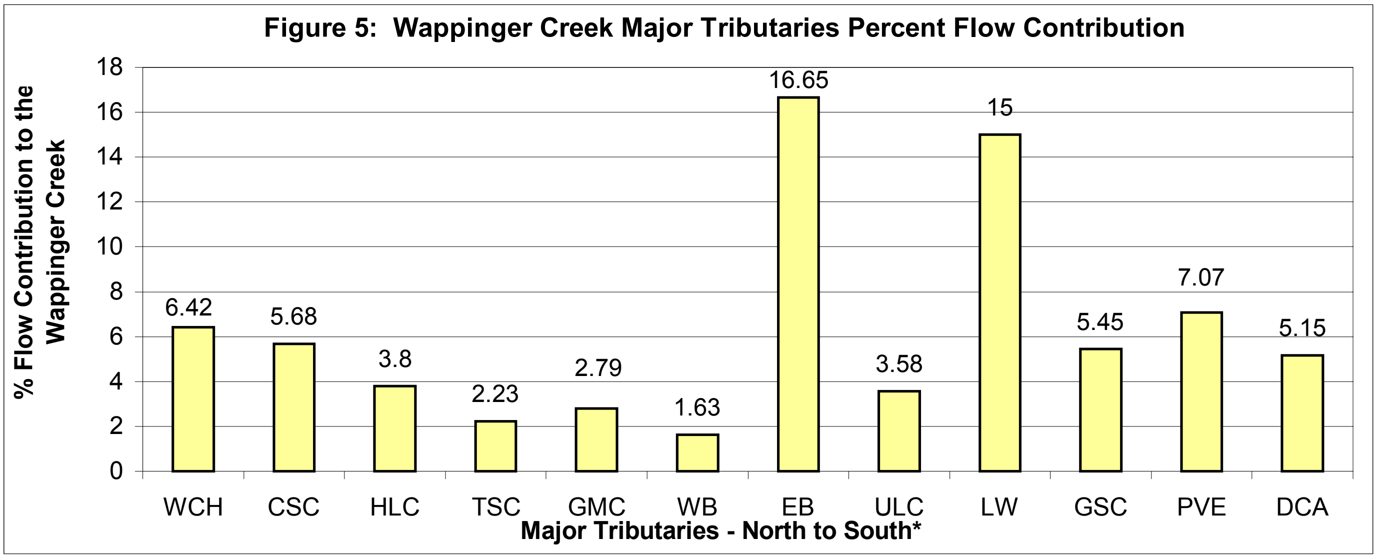
In conclusion, various land uses throughout the watershed contributed fairly high levels of nutrients and suspended sediment to the Wappinger Creek and Wappinger Lake during the study period (1998-1999). These levels indicate that remediation through best management practices (BMPs) is warranted. For more information, please see Section IV, where each subwatershed is explored further to target appropriate BMPs to nonpoint source pollution sources. In Section VI, categories of BMPs are suggested.

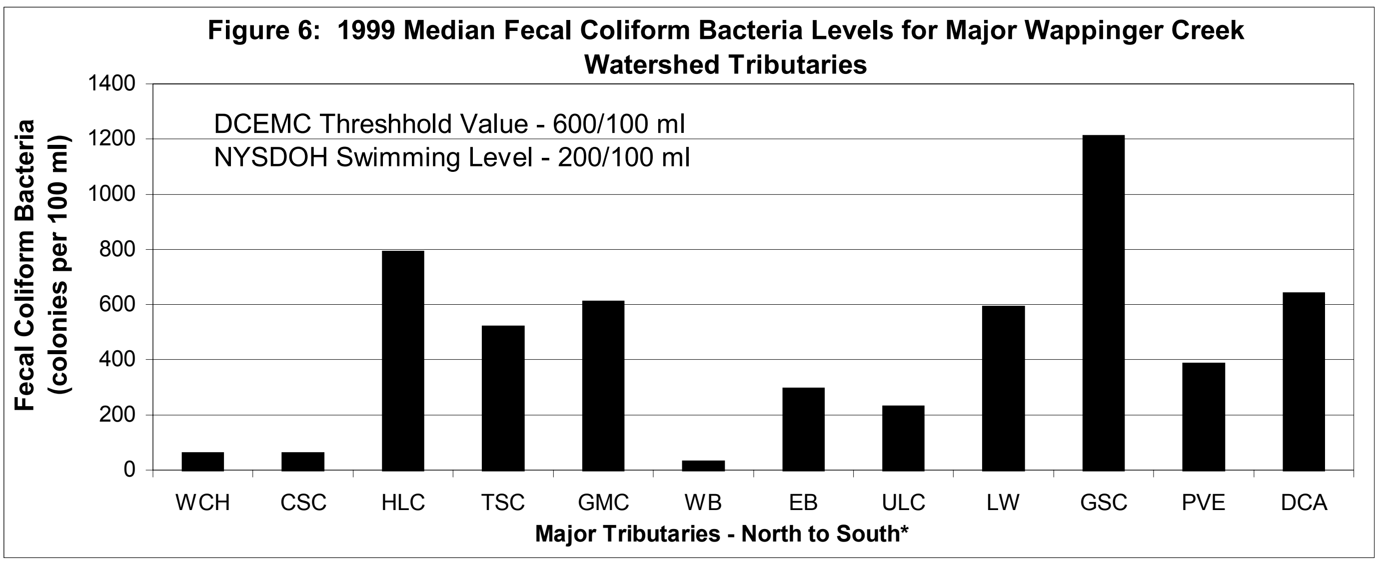






* = See Table 14 for full Tributary names





* = See Table 14 for full tributary names

Land Use Effects on the Filtering Capacity of Selected Wappinger Creek Watershed Wetlands, 1999[28]

INTRODUCTION

Wetlands provide important functions in the landscape including flood control, filtering of pollutants from surface water, and possibly groundwater recharge. The loss of wetlands can increase the threat of flood damage and increase the level of nutrients and sediment in streams and lakes. Even if wetlands are left intact, the ability of soils and plants in wetlands to provide these functions is influenced by surrounding land use. Since nutrient and sediment loading are the primary water quality impairments in the Wappinger Creek Watershed, it was important to find out whether the wetlands in the Wappinger Creek watershed were providing nutrient and sediment removal functions.

Therefore, a study of the relationship between surrounding land use and the filtering capacity of wetlands for removal of nutrients and suspended material was conducted from November 1998 to January 2000. The study was conducted by the Dutchess County Environmental Management Council (EMC) with support from Marist College, the Institute of Ecosystem Studies, and an EPA Wetlands and Watershed Planning Grant.

METHODS

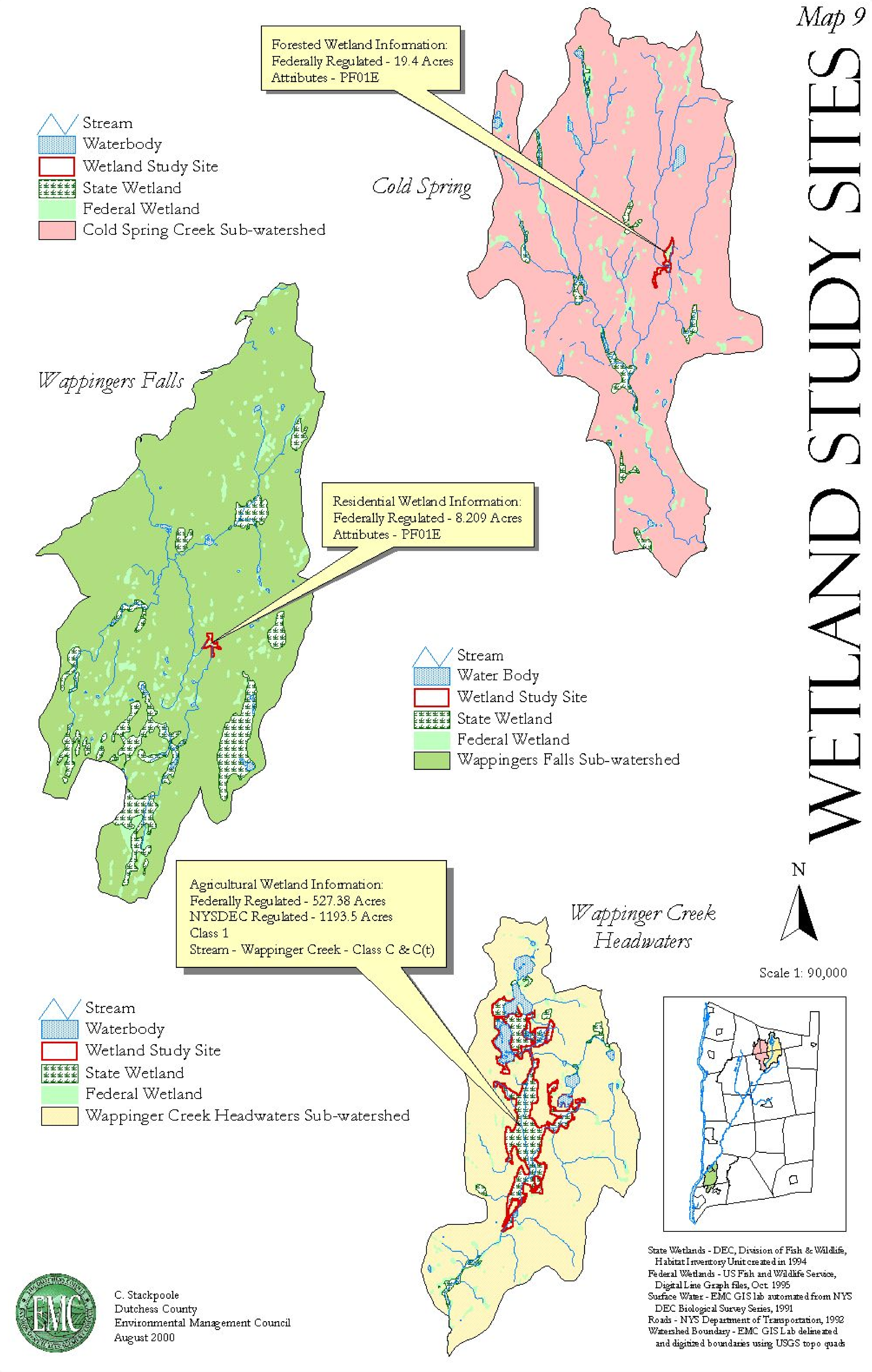
Three wetland sites were chosen according to the dominant land use in the Wappinger Creek subwatershed (agricultural, forested, and residential) in which they are located (Map 9). Water samples were analyzed for nitrate, phosphate, fecal coliform bacteria, temperature, and suspended materials. In addition, three sets of samples were analyzed for the following baseline chemistry variables: dissolved oxygen, pH, alkalinity, hardness, turbidity, and conductivity. Samples were analyzed according to American Public Health Association protocols in *Standard Methods for the Examination of Water and Wastewater*[29]. Additionally, project staff followed USEPA-approved quality assurance/quality control measures throughout the sampling and analysis process.[30]

RESULTS AND DISCUSSION

Functionally, the three wetlands of the Wappinger Creek basin studied throughout 1999 acted as sinks that trapped organic debris and subsequently released it following rainfall events and during the non-growing season (October – March). The residential and agricultural wetlands appeared to be filtering nutrients and suspended materials during the growing season (May – September). The forested wetland system was a pass-through system that received and released relatively low concentrations of nutrients and suspended materials.

The data demonstrated that the residential wetland received the greatest amount of nutrients in lbs./day/acre of wetland watershed, and the agricultural wetland received the greatest amount of suspended material in lbs./day/acre of wetland watershed. One of the more troubling findings of this study was the level of biological stress present in the agricultural wetland during the summer months. High bacteria levels reduced dissolved oxygen, which placed stress on the aquatic life.

This study was designed as a discrete look at what is occurring in three wetlands that were dominated by either agricultural, forested, or residential land use. Such a study was warranted as more and more wetlands are utilized, and even designed, for purposes that include treatment of storm water runoff and pollution discharge.


Map 9
WETLAND STUDY SITES
Forested Wetland Information:
Federally Regulated - 19.4 Acres
Attributes - PF01E
Stream
Waterbody
Wetland Study Site
State Wetland
Federal Wetland
Cold Spring Creek Sub-watershed
Cold Spring
Wappingers Falls
Residential Wetland Information:
Federally Regulated - 8.209 Acres
Attributes - PF01E
Stream
Water Body
Wetland Study Site
State Wetland
Federal Wetland
Wappingers Falls Sub-watershed
Agricultural Wetland Information:
Federally Regulated - 527.38 Acres
NYSDEC Regulated - 1193.5 Acres
Class 1
Stream - Wappinger Creek - Class C & C(t)
Wappinger Creek
Headwaters
N
Scale 1: 90,000
Stream
Waterbody
Wetland Study Site
State Wetland
Federal Wetland
Wappinger Creek Headwaters Sub-watershed
EMC
C. Stackpoole
Dutchess County
Environmental Management Council
August 2000
State Wetlands - DEC, Division of Fish & Wildlife, Habitat Inventory Unit created in 1994
Federal Wetlands - US Fish and Wildlife Service, Digital Line Graph files, Oct. 1995
Surface Water - EMC GIS lab automated from NYS DEC Biological Survey Series, 1991
Roads - NYS Department of Transportation, 1992
Watershed Boundary - EMC GIS Lab delineated and digitized boundaries using USGS topo quads

Biological Monitoring Study

<u>INTRODUCTION</u> *(for an explanation of some of the terms in this section see the glossary)*
The types of benthic macroinvertebrates (bottom dwelling organisms without a backbone) living in a stream are an excellent indicator of stream health. The types and numbers of invertebrates present can be compared to a "biotic index" (see Figure 7), which is a rough estimate of the pollution tolerance of the community. The biotic index will increase (from 0 to 10) with increases in pollution, including organic sources like sewage and manure. In general, the more pollution-tolerant invertebrates present the higher the pollution level in the stream.

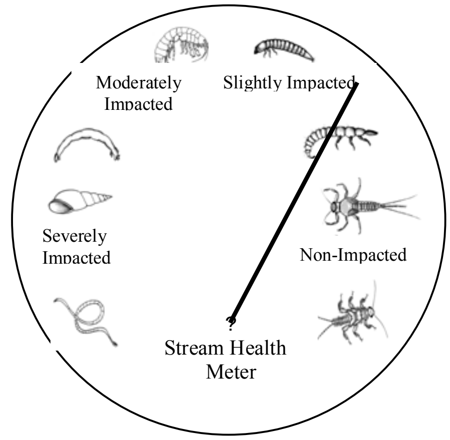


Figure 7. Biotic Index: The types and numbers of aquatic insects present can give an indication of pollution and disturbance levels in the stream

To look at the biological health of the Wappinger Creek and its tributaries, the EMC, in conjunction with Marist College, Dutchess County Soil and Water Conservation District, Institute of Ecosystem Studies, and the Mid-Hudson Chapter of Trout Unlimited, started a comprehensive volunteer biological stream monitoring effort in the spring of 1998. The volunteer biological monitoring program was designed to provide an understanding of the biologic health of the Wappinger Creek. Additionally, it was a cost-effective method of monitoring the long-term health of the watershed.

<u>METHODS</u>
Benthic macroinvertebrate communities and macroinvertebrate habitats were sampled in 1998 and 1999. Staff from the EMC identified eleven sites, with good macroinvertebrate habitat, for the volunteers to collect the biological samples. The aquatic invertebrate communities were sampled using methods consistent with the USEPA's "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, Second Edition"[31]. Macroinvertebrates were collected by citizens of all ages in late March before the water temperature began to rise and the insects began to hatch, and in October before the major leaf fall. The macroinvertebrate samples were identified by volunteers to the order level at science labs located at Marist College. Following the initial sort and order level identification, staff from the EMC and Marist College identified the samples to the family level.

<u>RESULTS and DISCUSSION</u>
Based on yearly values, the biotic index rose at all the sites and the organism density per sample dropped at all the sites from 1998 to 1999 (the organism density per sample reflects the number of macroinvertebrates living in the stream). In general, density will decrease when organic matter decreases and habitat conditions decline. Organism density will also decrease with increased sedimentation, toxic inputs, and low pH.

When analyzed by type of insect, the samples were dominated by "gathering collectors" throughout the watershed, with the exception of the Mountain Road site that was dominated by "filtering collectors". A dominance of gathering collectors throughout the watershed could be an indicator of human and natural organic inputs deposited on the stream bottom.

Filtering collectors were the dominant feeding group at the Mountain Road site. These macroinvertebrates will filter fine particulate matter from the water column, and their presence shows that there is an abundance of material in the water for the invertebrates to feed on. An agricultural enterprise and a large wetland (1,193 acres) upstream of the Mountain Road sampling site are the most likely causes of the high amount of suspended material utilized by the filtering collectors.

The wetland and the agricultural land use contributed a large amount of organic material and sediment to the water column. In turn, these contributions caused dissolved oxygen levels to plummet in the summer months. These effects were outlined in the study of the agricultural wetland[32].

The EPT family richness measures the number of families of the order Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) that were represented at a sample site. These orders are known to contain many taxa that are sensitive to water quality changes. Generally, the more EPT families, the better the water quality and habitat. The EPT family richness of the Mountain Road site was low, but was good throughout the rest of the stream.

Volunteers collecting macroinvertebrate samples

CONCLUSIONS

With the exception of the Mountain Road site, the data collected by volunteers in 1998 and 1999 showed the Wappinger Creek to be slightly impacted. The most likely sources of the impairment were nutrient inputs and siltation. These findings are consistent with the New York State Department of Environmental Conservation's 1998 findings from the Wappinger Creek in Poughkeepsie.

In addition, the rising biotic index and falling organism density per sample from 1998 to 1999 was interesting. This could have been attributed to a bad water year in 1999, or an increase in nutrient inputs and sedimentation. The Mountain Road community seemed to be moderately impacted by the large wetland, intensively used barnyard, and stream channelization. Biological samples collected in the years to come will provide us with a clear picture of water quality trends over time.

IV. Analysis of Sources of Pollution

Problem definition

The chemical and biological water quality data collected over the past three years shows that there are some areas where nonpoint source pollution has caused elevated nutrient and sediment levels in Wappinger Creek tributaries. Point source pollution, primarily from sewage disposal systems under the State Pollution Discharge Elimination System (SPDES) permit program, also contributes to nutrient loading (See individual subwatershed maps #10-25 for locations; for an explanation of the SPDES program see page 10). Fecal coliform bacteria levels are above Health Department allowable levels for swimming in several areas, and may be caused by animal waste, septic systems and surface discharge pipes.

To facilitate analysis of sources of pollution, each subwatershed was studied separately for point and nonpoint source inputs. To achieve this analysis, basic characteristics such as land use[33] and NYSDEC water quality classifications were analyzed. Table 8 provides a summary comparison of the land use in each of the 16 subwatersheds. Tables 9 and 10 compare the number of SPDES permits and the number of animal units in each subwatershed, which may have a cumulative impact on nitrate, phosphate and bacteria loading.

Tables 11, 12 and 13 provide information on landfill sites and petroleum bulk storage facilities. Since all landfills in the watershed are closed and capped, these areas are not expected to have an impact on surface water. However, groundwater may have been impacted where landfills were improperly constructed. While pollutant loading from petroleum facilities was not analyzed during the course of the stream monitoring program, the potential for petroleum spills is greater in areas where there are a large number of storage facilities.

In addition to the land use comparison, soil types from the Dutchess County Soil Survey[34] were researched in order to compare nutrient filtering capacity and erosion potential. Soil type is important because the physical and chemical properties of soil determine the ability of the soil to support a septic system or a building foundation. Additionally, soil type controls the extent of plant root growth under the soil surface, and the volume of soils that serves as a reservoir for water and essential nutrients for plants. The soil descriptions provided here are generalized; for detailed descriptions see the *Dutchess County Soil Survey*[35].

Table 8. Subwatershed Land Use Comparison (#1 indicates the highest percent, #16 the lowest %)

Sub-watershed ID #	Subwatershed Grouping	Rank: Total Area	Rank: % Forested Area	Rank: % Agricultural Area	Rank: % Developed Area	Rank: % Wetlands
1	Wappinger Creek Headwaters	4	8	2	15	1
2	Cold Spring Creek	8	1	14	11	13
3	Little Wappinger	2	3	11	9	5
4	Hunns Lake Creek	12	7	4	13	15
5	Grist Mill	14	6	6	12	8
6	Willow Brook	15	10	1	10	16
7	Tamarack Swamp	6	2	8	16	10
8	Upton Lake	11	11	3	8	14
9	East Branch	1	5	7	14	11
10	Great Spring Creek	3	13	5	7	4
11	Pleasant Valley East	5	4	13	6	9
12	Overlook Road	9	12	10	5	7
13	Direct Drainage West	13	15	16	1	12
14	Direct Drainage East	16	16	9	2	3
15	Dutchess County Airport	7	14	12	4	6
16	Wappinger Falls	10	9	15	3	2

Table 9. State Pollution Discharge Elimination Permits (SPDES)		
Subwatershed	**# of Permits**	**Rank**
Cold Spring Creek (#2)	1	11
Little Wappingers (#3)	7	7
Hunns Lake Creek (#4)	4	9
Tamarack Swamp (#7)	1	11
Upton Lake Creek (#8)	3	10
East Branch (#9)	10	4
Great Spring Creek (#10)	15	2
Pleasant Valley East (#11)	4	9
Overlook Road (#12)	13	3
Direct Drainage West (#13)	9	5
Direct Drainage East (#14)	4	8
Dutchess County Airport (#15)	8	6
Wappingers Falls (#16)	24	1
All other subwatersheds	0	

Table 10. Number of Animal Units		
Subwatershed	**# Animal Units**	**Rank**
Wappinger Creek Headwaters (#1)	437.6	2
Cold Spring Creek (#2)	33	11
Little Wappingers (#3)	153.3	7
Hunns Lake Creek (#4)	103.1	9
Grist Mill (#5)	44	10
Willow Brook (#6)	217	5
Tamarack Swamp (#7)	261.2	4
Upton Lake (#8)	213.7	6
East Branch (#9)	672.6	1
Great Spring Creek (#10)	397.7	3
Pleasant Valley East (#11)	141.1	8
Overlook Road (#12)	29.6	12
Direct Drainage West (#13)	0	13
Direct Drainage East (#14)	0	13
Dutchess County Airport (#15)	0	13
Wappingers Falls (#16)	0	13

Table 11. Inactive Landfill Sites		
Subwatershed	**Landfill Site Name**	**Date of Delisting by NYS**
Wappinger Creek Headwaters (#1)	Pine Plains	
Cold Spring Creek (#2)	Wilcox Park	
Little Wappingers (#3)	Clinton	1995
Little Wappingers (#3)	Milan	
Hunns Lake Creek (#4)	Stanford	
East Branch (#9)	Washington	
East Branch (#9)	Millbrook	1991
Pleasant Valley East (#11)	Pleasant Valley	1994
Dutchess County Airport (#15)	Dutchess County Airport	1992
Dutchess County Airport (#15)	Dutchess County Airport Balefill	1992
Wappingers Falls (#16)	Wappingers Falls	1991

Table 12. Petroleum Bulk Storage Facilities (1100 gal. - 400,000 gal.)	
Subwatershed	**Number of Facilities**
Wappinger Creek Headwaters (#1)	7
Cold Spring Creek (#2)	1
Upton Lake (#8)	1
East Branch (#9)	26
Great Spring Creek (#10)	12
Pleasant Valley East (#11)	2
Overlook Road (#12)	13
Direct Drainage West (#13)	33
Direct Drainage East (#14)	5
Dutchess County Airport (#15)	13
Wappingers Falls (#16)	23

Table 13. Major Oil Storage Facilities

Major Oil Storage Facilities (more than 400,000 gallons) - There are two listed in the Watershed in the East Branch subwatershed (#9)

Chemical Bulk Storage Facilities - There are none listed in the Watershed

Table 14. Land Use Impacts and Associated Nonpoint Source Pollution in Wappinger Creek Subwatersheds (North to South)*

	Pine Plains		*Milan*		*Clinton*			*Stanford*									*Washington*		*Village of Millbrook*
WC Subsheds	**WCH**	**CSC**	**CSC**	**LWC**	**LWC**	**ULC**	**GSC**	**WCH**	**CSC**	**HLC**	**TSC**	**ULC**	**GMC**	**WB**	**EB**	**LWC**	**EB**	**TSC**	**EB**
Impairment																			
Impoundment				X	X			X							X	X	X		X
Litter/ Dumping							X												
Construction							X												
Streambank Erosion	X			X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Diminished Riparian Buffer	X							X		X				X					
Pipe Discharges							X								X		X		X
Channel/Bank Manipulation	X							X		X									
Septic Systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Excessive Algae							X												
Mining										X	X				X		X	X	X
Lake Impairment	X			X		X		X		X		X				X			

* See explanation of this table on page 47

Table 14. Land Use Impacts and Associated Nonpoint Source Pollution in Wappinger Creek Subwatersheds (North to South) Cont.*

Towns	*Pleasant Valley*						*Hyde Park*	*LaGrange*				*Poughkeepsie*		*Wappinger*		*Village of Wappinger Falls*		*Fishkill*
WC Subsheds	**GSC**	**PVE**	**LWC**	**ULC**	**ORC**	**EB**	**GSC**	**PVE**	**ORC**	**DCA**	**DDE**	**GSC**	**DDW**	**DCA**	**WFC (HC)**	**WFC (HC)**	**DDW**	**WFC (HC)**
Impairment																		
Impoundment		X	X			X		X		X	X		X	X			X	
Litter/ Dumping	X						X			X	X	X	X	X	X	X	X	X
Construction	X	X			X		X	X	X	X	X	X	X	X	X	X	X	X
Streambank Erosion	X	X	X	X	NA	X	X	X	NA	X	X	X	X	X	NA	NA	X	NA
Diminished Riparian Buffer											NA		NA				NA	
Pipe Discharges	X				X	X	X		X	X	X	X	X	X	X	X	X	X
Channel/Bank Manipulation															NA	NA		NA
Septic Systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Excessive Algae	X	X			NA		X	X	NA		NA	X	NA		NA	NA	NA	NA
Mining		X			X	X	X		X									
Lake Impairment			X	X									X		X	X	X	X

Wappinger Creek Subwatersheds and Abbreviations

GSC	Great Spring Creek	ORC	Overlook Road Creek	DDW	Direct Drainage West
TSC	Tamarack Swamp Creek	WCH	Wappinger Creek Headwaters	HLC	Hunns Lake Creek
CSC	Cold Spring Creek	LWC	Little Wappingers Creek	WFC (HC)	Wappinger Falls Creek (Hunter Creek)
EB	East Branch of Wappingers Creek	WB	Willow Brook	GMC	Grist Mill Creek
PVE	Pleasant Valley East	DDE	Direct Drainage East	DCA	Dutchess County Airport
ULC	Upton Lake Creek				

* See explanation of this table on page 47

Table 15. Quantitative Analysis of Nonpoint Source Pollution in the Wappinger Creek Subwatersheds (North to South)

	Pine Plains		***Milan***		***Clinton***			***Stanford***									***Washington***		***Village of Millbrook***
WC Subsheds	**WCH**	**CSC**	**CSC**	**LWC**	**LWC**	**ULC**	**GSC**	**WCH**	**CSC**	**HLC**	**TSC**	**ULC**	**GMC**	**WB**	**EB**	**LWC**	**EB**	**TSC**	**EB**
Impairment																			
Elevated Suspended Sediment	X						X	X							X		X		X
Elevated Fecal Coliform Bacteria				*	*	*	X *			X *	*	*	X *	X *	*	*	*	*	*
Elevated Phosphates	X *						X *	X *						X *	X		X		X
Elevated Nitrates						X *	X *			X *	*	X *		X *	*		*	*	X *

X = Elevated according to the standards developed by the EMC. These standards are based on concentrations that existed in the Wappinger Creek watershed in 1999. Those with elevated levels are in the in the top 1/3, as compared to the remainder of the Wappinger Creek watershed subwatersheds.

* = Elevated according to values which exist in literature[36,37]. These are thresholds developed through other scientific studies that demonstrated adverse effects on waterways once levels exceed these values.

Thresholds Developed by the DCEMC			
NO_3	PO_4	Suspended Solids	Fecal Coliform Bacteria
1.8 mg/L	.047 mg/L	4.34 mg/L	600/100

Thresholds Determined by Literature Values			
NO_3	PO_4	Suspended Solids	Fecal Coliform Bacteria
1.0 mg/L	.05 mg/L	NA	200/100

Note: Please see pages 30 and 31 for descriptions of parameters and clarification of threshold values. See page 47 for a complete explanation of this table.

Table 15. Quantitative Analysis of Nonpoint Source Pollution in the Wappinger Creek Subwatersheds (North to South) Continued

Towns	*Pleasant Valley*						*Hyde Park*	*LaGrange*				*Poughkeepsie*		*Wappinger*		*Village of Wappinger Falls*		*Fishkill*
WC Subsheds	**GSC**	**PVE**	**LWC**	**ULC**	**ORC**	**EB**	**GSC**	**PVE**	**ORC**	**DCA**	**DDE**	**GSC**	**DDW**	**DCA**	**WFC (HC)**	**WFC (HC)**	**DDW**	**WFC (HC)**
Impairment																		
Sediment	X	X			NA	X	X	X	NA	X	NA	X	NA	X	NA	NA	NA	NA
Elevated Fecal Coliform Bacteria	X *	*	*	*	NA	*	X *	*	NA	X *	NA	X *	NA	X *	NA	NA	NA	NA
Elevated Phosphates	X *	X *			NA	X	X *	X *	NA		NA	X *	NA		NA	NA	NA	NA
Elevated Nitrates	X *			X *	NA	*	X *		NA	X *	NA	X *	NA	X *	NA	NA	NA	NA

Wappinger Creek Subwatersheds and Abbreviations

GSC	Great Spring Creek	ORC	Overlook Road Creek	DDW	Direct Drainage West
TSC	Tamarack Swamp Creek	WCH	Wappinger Creek Headwaters	HLC	Hunns Lake Creek
CSC	Cold Spring Creek	LWC	Little Wappingers Creek	WFC (HC)	Wappinger Falls Creek (Hunter Creek)
EB	East Branch of Wappingers Creek	WB	Willow Brook	GMC	Grist Mill Creek
PVE	Pleasant Valley East	DDE	Direct Drainage East	DCA	Dutchess County Airport
ULC	Upton Lake Creek				

Table 14 summarizes the various land use practices that may have an impact on water quality in each subwatershed. Impoundments (dams) alter water levels and have an impact on fish and other aquatic life. Construction and mining can cause sedimentation when proper erosion control methods are not used. As a result, sedimentation destroys fish spawning areas, eliminates aquatic food sources, increases water temperatures, reduces photosynthesis, and causes gill abrasion. Since fishing is the major recreational activity in lakes and streams in the watershed, it is important to identify the causes of sedimentation.

A diminished riparian buffer reduces the ability of the streambank vegetation to filter out nutrients and sediment before they reach the stream or lake. During rainfall events, nutrients and other pollutants are transported to waterbodies by stormwater runoff. These pollutants may be dissolved in surface water, percolate down to the groundwater, or can become attached to sediment particles. Elevated nutrients, in turn, cause algae blooms and excess weed growth, which impairs recreation and reduces oxygen levels necessary for fish survival. Septic systems when malfunctioning or improperly installed can also cause bacteria and nutrient loading, therefore precluding the use of the water body for swimming and other contact recreation. Excessive algae are an indicator of nutrient loading, especially in streams where natural levels of nutrients are low.

To provide a basis for recommending best management practices, the water quality data is compared to two different reference values in Table 15. First, nutrient concentrations were compared to literature values and fecal coliform bacteria levels were compared to NYS Department of Health standards. Many of the subwatershed tributaries exceeded these criteria. Second, the EMC staff calculated the median pollutant concentration values from all of the sampling sites, and identified those that exceeded the median value two-thirds of the time. These are the subwatersheds that have the highest levels of pollution, and should be targeted first for implementation of best management practices. These values are also summarized in Figures 2, 3, 4, 5 and 6.

Based on this data comparison, probable pollution inputs in each subwatershed are identified in the next sub-section *(Subwatershed Impact Summaries)*, and possible future threats to water quality are noted. Suggestions for management to reduce impacts to the subwatersheds and cumulative impacts to the Wappinger Creek are provided in Section VI.

Subwatershed Impact Summaries

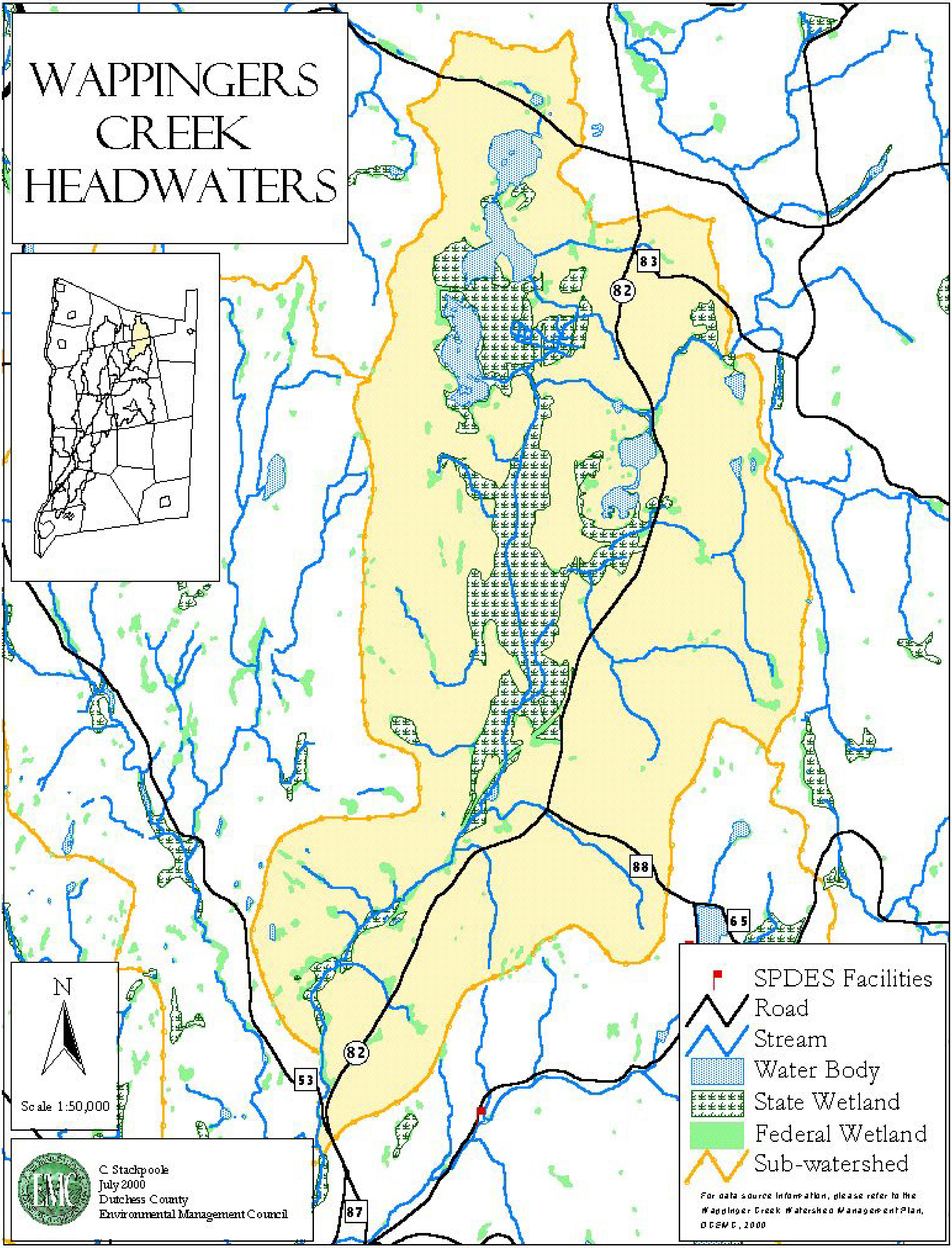
Wappinger Creek Headwaters

The Wappinger Creek Headwaters subwatershed encompasses 9,430 acres in the northern portion of the Wappinger Creek watershed (Map 10*). Contained within the Towns of Pine Plains and Stanford, the subwatershed comprises 7% of the Wappinger Creek watershed. Subwatershed land use consists of 38% agriculture (the second-highest amount of agricultural land use of all the subwatersheds), 40% forested, 8% residential, 13% wetland and waterbodies, .05% gravel mining, .17% light manufacturing, and .5% public land and outdoor recreation. The headwaters stream contributes 6.4% of the total major tributary flow to the Wappinger Creek (Figure 5).

Well-drained soils are found in 78% of the subwatershed, while 26% of the subwatershed contains hydric (wetland) soils. The dominant soil types in the subwatershed are Hoosic gravelly loam at 19% and Nassau-Cardigan complex at 10%. These soils tend to be well drained and have a moderate permeability, with some areas of shallow soils, sandy soils, or steep slopes. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth. The Hoosic, Nassau, and Cardigan soil series are poor for septic systems due to the rapid permeability.

The New York State Department of Environmental Conservation (NYSDEC) has

* For map data sources see Appendix 9.



WAPPINGERS
CREEK
HEADWATERS
83
82
88
65
82
53
87
N
Scale 1:50,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
C Stackpoole
July 2000
Dutchess County
Environmental Management Council

classified the Wappinger Creek Headwaters as a class C and C(t) stream, which indicates that it will support fish[38] (See Table 5). The tributaries to the headwaters are classified as B and D waters. Portions of the Headwaters downstream of the Buttercup Sanctuary (Class C) should support trout populations, but fish will probably not reproduce there.

The headwaters discharge from a chain of lakes at the base of Stissing Mountain, named Twin Island Pond, Stissing Lake, and Thompson Pond. These waterbodies have been given a B classification by the NYSDEC, although two out of the three (Twin Island Pond and Stissing Lake) have been listed on the NYSDEC priority water list (PWL) for several years[*39]. The PWL indicates that these lakes are stressed by excess nutrients primarily from on-site septic systems. The lakes produce an abundance of aquatic vegetation during the summer months, which is an indication of excess nutrient loading into the lake. The nutrient loading can probably be attributed to on-site septic systems and fertilizer applications to lakeside property.

The Wappinger Creek Headwaters contained water quality monitoring locations for both the tributary study and the wetland filtering study described in Section III. A comparison of the monitoring results provides a preliminary analysis of the capacity of a large wetland to buffer an intensive agricultural operation.

When compared with the other 15 subwatersheds, the Headwaters contains the highest percentage of wetland area (Table 8). The Headwaters stream flows through a 1,193-acre wetland, designated Class 1 by the NYSDEC due to its large size. Before entering the wetland the stream flows through an intensively used barnyard and agriculture operations. It is also important to note that this subwatershed contains the second-highest number of animal units (see Table 10).

The results of the wetland filtering study show that upstream values of nutrients and suspended material are higher than downstream values during the growing season (May – September), therefore these wetlands appear to be filtering nutrients and suspended materials at certain times of the year. However, the tributary monitoring study showed that downstream of the wetland, the median phosphate and suspended material levels in the Headwaters stream exceeded the criteria developed by the EMC in 1999 (Figures 3 and 4). During the nongrowing season and following storm events the wetland is releasing the excess suspended materials and nutrients. Therefore, even though the wetland is filtering out sediment with attached phosphorus during the growing season, phosphorous becomes resuspended in the water column when wetland sediments are disturbed, especially in the nongrowing season. This also indicates that the overall nutrient filtration function of the wetland was minimal[40].

Median Pollutant Concentration Values (mg/L) for Wappinger Creek Headwaters stream

NO_3	PO_4	Suspended Solids	Fecal Coliforms
.23	.055	4.34	60

Another indication of the filtering capacity of the large wetland in the Headwaters subwatershed is extremely high fecal coliform bacteria levels upstream of the wetland and low levels downstream of the wetland. Many of the organisms associated with fecal coliform bacteria cannot survive for long periods of time outside their host organism. Therefore, the wetland function of retaining suspended material promotes the die-off of the fecal coliform bacteria.

The watershed planning team recommends the implementation of properly designed agricultural best management practices and proper septic system siting and maintenance to help alleviate some of the water quality impacts in the Headwaters. Also, there were several sites in the Headwaters where the stream vegetative buffer zone was being destroyed. The destruction of this vegetated buffer zone

[*] See footnote on page 7 for an explanation.

increases sediment and nutrient loading to the stream, warms water temperatures, and threatens the ability of aquatic life to reproduce. Therefore, it should be a priority to restore and maintain naturally vegetated stream buffers in this subwatershed.

Cold Spring Creek

The Cold Spring Creek subwatershed encompasses 7,454 acres in the northern portion of the Wappinger Creek watershed, and 6% of the entire Wappinger Creek watershed (Map 11).

The subwatershed includes portions of the towns of Pine Plains, Milan, and Stanford. Subwatershed land use consists of 75% forest (the highest amount of forested land use of all the subwatersheds), 7% agriculture, 7% residential, 7% outdoor recreation, and 4% wetland and waterbodies. Additionally, the subwatershed contributes 5.6% of the major tributary flow to the Wappinger Creek (Fig. 5).

Soil type in the subwatershed varies greatly. It is dominated by Nassau-Cardigan complex (31%), well-drained soils with a moderate permeability. These soils tend to provide water to plants throughout the growing season, and do not inhibit growth for significant amounts of time during wet period, however they are poor for septic systems due to rapid permeability. The New York State Department of Environmental Conservation classifies Cold Spring Creek as a class B stream (See Table 5) which means Cold Spring Creek should be suitable for swimming, fish reproduction and fish survival.

The Cold Spring Creek subwatershed median nutrient (phosphate and nitrate), suspended material, and fecal coliform bacteria concentrations for January through December 1999 were all below the levels derived by the EMC that could indicate significant human-related inputs (Figures 2, 3, 4 and 6). Certainly, the large percentage of forested land use acted as a buffer for the existing human-related inputs.

The Cold Spring Creek subwatershed drainage area includes Mountain Brook. Mountain Brook is a class C(t) and B(ts) stream with documented trout reproduction. This tributary to Cold Spring Creek showed evidence of possible degradation from past logging practices, but appeared to have recovered in recent years. Low alkalinity levels in Mountain Brook suggest the stream ecosystem is a sensitive system that cannot buffer large amounts of acidic inputs. Therefore, it is imperative to keep this delicate balance in place, and keep one of the few remaining trout breeding streams in good health.

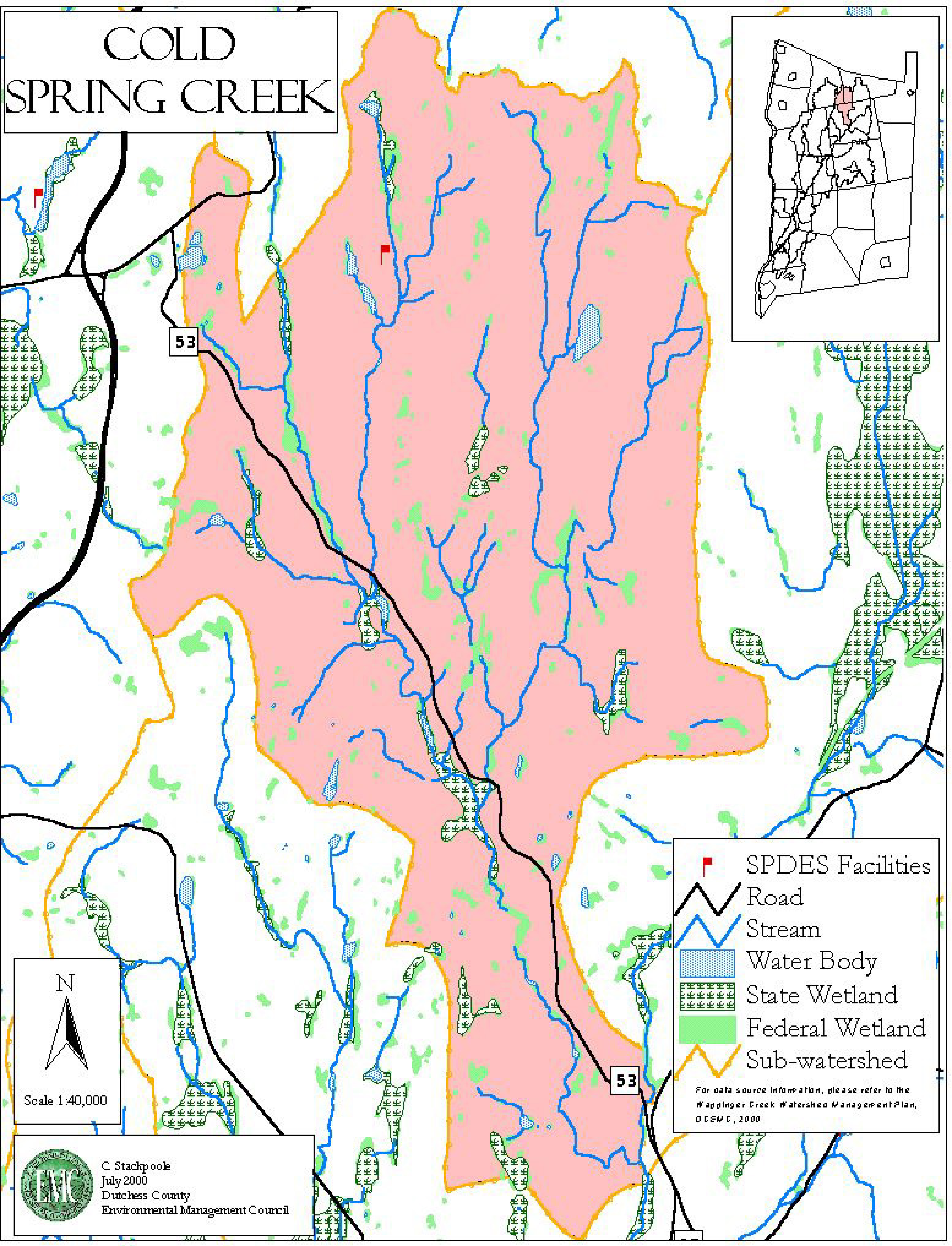
The Cold Spring Creek subwatershed appeared to be in relatively good health in 1999. However, future threats to the subwatershed would include poorly planned development and agriculture and logging operations without proper best management practices. Specifically, this would include poor septic system siting, destruction of stream vegetative buffer zones, poorly managed logging roads, and agriculture operations that do not employ best management practices. The watershed planning team recommends best management practices are employed to avoid water quality degradation, and a concerted effort should be made to properly site septic systems.

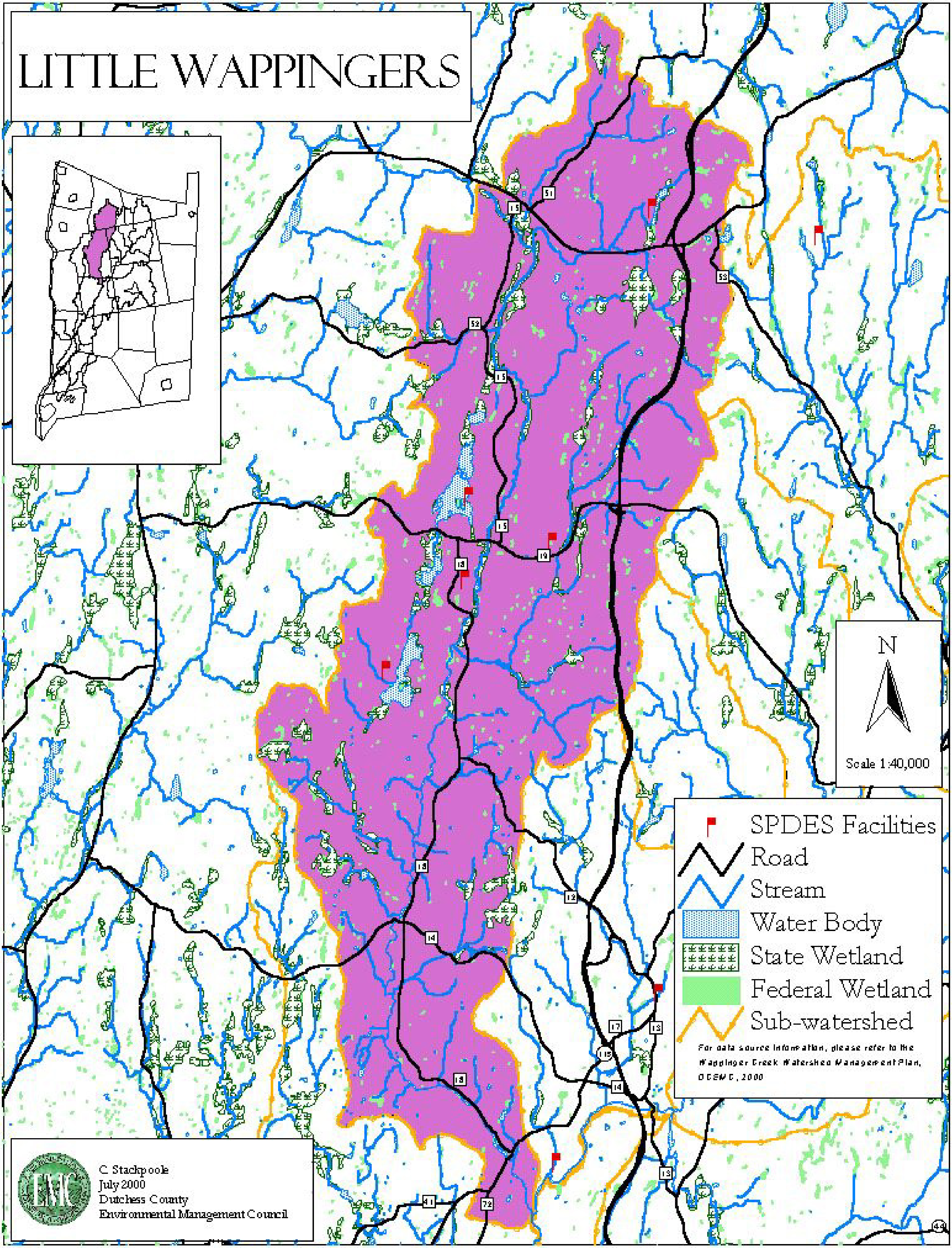
Median Pollutant Concentration Values (mg/L) for Cold Spring Creek

NO_3	PO_4	Suspended Solids	Fecal Coliforms
.46	.034	.87	60

Little Wappinger Creek

The Little Wappinger Creek subwatershed encompasses 21,296 acres in the northwestern portion of the Wappinger Creek watershed (Map 12). Contained within the Towns of Milan, Clinton, Stanford, and Pleasant Valley, this subwatershed is the second largest in the Wappinger Creek watershed, comprising 16% of the entire watershed area. Subwatershed land use consists of 17% agriculture, 56% forested (third highest among all subwatersheds), 17% residential, 6% wetland and waterbodies, 2% transportation and communication, and .8% public land and outdoor recreation. The stream contributes 15% of the total major tributary flow to the Wappinger Creek (Figure 5).


COLD
SPRING CREEK
53
53
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the
Wappinger Creek Watershed Management Plan,
DCEMC, 2000
N
Scale 1:40,000
C Stackpoole
July 2000
Dutchess County
Environmental Management Council


LITTLE WAPPINGERS
N
Scale 1:40,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the
Wappinger Creek Watershed Management Plan,
DCEMC, 2000
EMC
C Stackpoole
July 2000
Dutchess County
Environmental Management Council

Well-drained soils are found in 71% of the subwatershed. The dominant soil types are Hoosic gravelly loam at 17% and Nassau-Cardigan complex at 9%. These soils tend to be well-drained, sometimes due to shallow soils, sandy soils, or steep slopes, and have a moderate

to rapid permeability, making them poor for septic system siting. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth.

The New York State Department of Environmental Conservation (NYSDEC) has classified the Little Wappinger Creek as a class B stream (see Table 5), indicating that it is suitable for swimming, fishing and fish reproduction. The Little Wappinger Creek subwatershed also contains an important chain of lakes consisting of Silver Lake, Mud Pond, and Long Pond. Long Pond and Silver Lake are classified as AA and AA(t) waters by the NYSDEC, meaning that they can be used as a drinking water source when disinfected (see Table 5) and support trout. Mud Pond has been given a B classification, indicating that it is suitable for swimming, fishing and fish reproduction.

Although Long Pond and Silver Lake have the highest water quality classifications in the watershed (AA and AA(t)), they have both been listed on the NYSDEC priority water list as stressed by excess nutrients[41]. Excess aquatic vegetation in the lakes is an indication of excess nutrient loading into the lake, probably from on-site septic systems and fertilizer applications to lakeside property.

Median suspended material, fecal coliform bacteria, nitrate, and phosphate concentrations in the Little Wappinger Creek for 1999 existed below the threshold developed by the EMC (Figures 2, 3, 4 and 6). However, suspended material, phosphate, and fecal coliform bacteria concentrations were approaching the designated thresholds. Future threats to the subwatershed would include poorly planned development and agriculture operations without proper best management practices. Specifically, this would include poor septic system siting, destruction of stream vegetative buffer zones, poorly planned residential development, and agriculture operations that do not employ best management practices. Although pollutant levels are currently below DCEMC threshold values, they are approaching elevated levels. Therefore, the watershed planning team recommends best management practices are employed to avoid water quality degradation, and a concerted effort should be made to properly site septic systems.

Median Pollutant Concentration Values (mg/L) for the Little Wappinger Creek

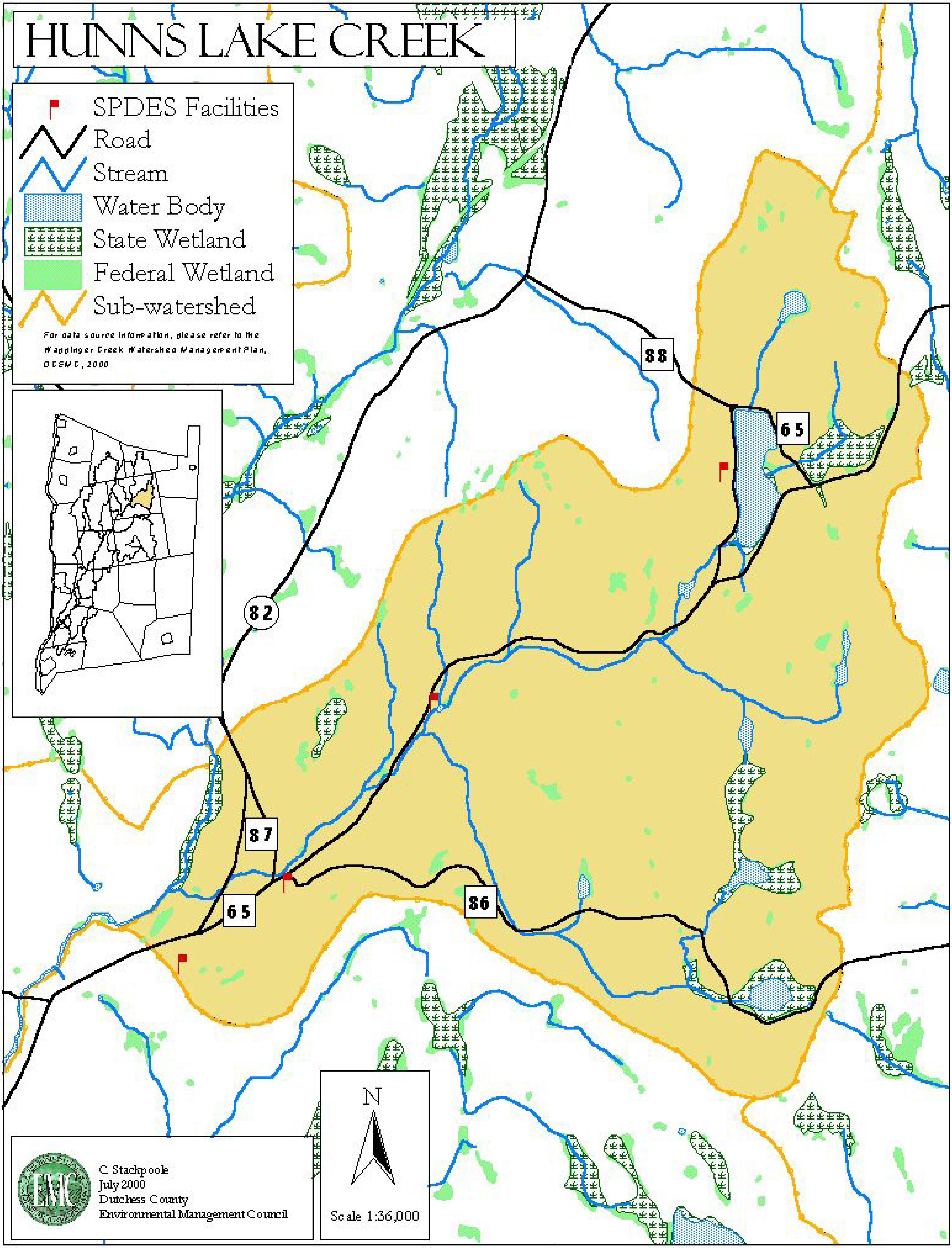
NO_3	PO_4	Suspended Solids	Fecal Coliforms
.93	.04	3.7	590

Hunns Lake Creek

The Hunns Lake Creek subwatershed encompasses 5,407 acres in the northeastern portion of the Wappinger Creek watershed (Map 13). It is contained entirely within the Town of Stanford and comprises 4% of the Wappinger Creek watershed. Subwatershed land use consists of 32% agriculture (fourth highest among all subwatersheds), 51% forested, 13% residential, 3% wetland and waterbodies, 1% sand and gravel mining, and .04% public land. The stream contributes 3.8% of the total major tributary flow to the Wappinger Creek (Fig. 5).

The dominant soil types in the subwatershed are Nassau-Cardigan complex (27%), Hoosic Gravelly loam (9%), Stockbridge silt loam (9%), and Sun silt loam (8%). The Nassau-Cardigan complex, Stockbridge silt loam, and Hoosic gravelly loam tend to be well drained and have a moderate to rapid permeability. Sun silt loam is a hydric (wetland) soil with poor drainage and a slow permeability. All of these soil types tend to be poor for septic system siting.

The New York State Department of Environmental Conservation (NYSDEC) has classified Hunns Lake Creek as a class B and C(t) stream (See Table 5), indicating that it will support swimming in some areas (B) but is limited to fishing (C) in other areas. While



HUNNS LAKE CREEK
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
88
65
82
87
65
86
C Stackpoole
July 2000
Dutchess County
Environmental Management Council
N
Scale 1:36,000

Hunns Lake Creek should support trout populations, reproduction will probably not take place in this stream. Additionally, a 3-mile segment of Hunns Lake Creek is listed on the NYSDEC priority water list due to high biological oxygen demand[42]. The source of the biological oxygen demand appears to be an agricultural operation.

The headwaters of Hunns Lake Creek discharge from Hunns Lake. 65 acres in size, Hunns Lake has been given a class B designation by the NYSDEC. This lake has been listed on the NYSDEC priority water list as stressed by excess nutrients (nitrates and phosphates)[43]. Nutrient loading from on-site septic systems and fertilizer applications to lakeside property are most likely the cause of excess aquatic vegetation in Hunns Lake during the summer months.

In Hunns Lake Creek, the median nitrate and fecal coliform bacteria levels exceeded the criteria developed by the EMC (Figures 2 and 6). The sources of these high levels appeared to be septic systems and agriculture operations. The nitrate contamination in Hunns Lake Creek could probably be attributed to poorly planned pastures and the rapid groundwater transport of nitrate from local septic systems. In addition, following rainfall events fecal coliform bacteria levels in the stream were extremely high. The most likely source of the high bacteria levels appeared to be an upstream recreation center's horse pasture.

Median Pollutant Concentration Values (mg/L) for Hunns Lake Creek

NO_3	PO_4	Suspended Solids	Fecal Coliforms
2.3	.043	2.07	790

Hunns Lake Creek transported relatively high nitrate and bacteria concentrations to the Wappinger Creek in 1999. The watershed planning team recommends the fencing of stream banks in pastures, proper septic system siting and maintenance, increased stream vegetative buffers, and properly designed residential and agricultural best management practices to help alleviate some of the impacts to Hunns Lake and Hunns Lake Creek.

Grist Mill Creek

The Grist Mill Creek subwatershed encompasses 4,257 acres in the north-central portion of the Wappinger Creek watershed (Map 14). It is located entirely within the Town of Stanford and comprises 3% of the entire Wappinger Creek watershed. Subwatershed land use consists of 30% agriculture, 51% forested, 13% residential, 5.5% wetland and waterbodies, and .08% public land. The stream contributes 2.8% of the total major tributary flow to the Wappinger Creek (Figure 5).

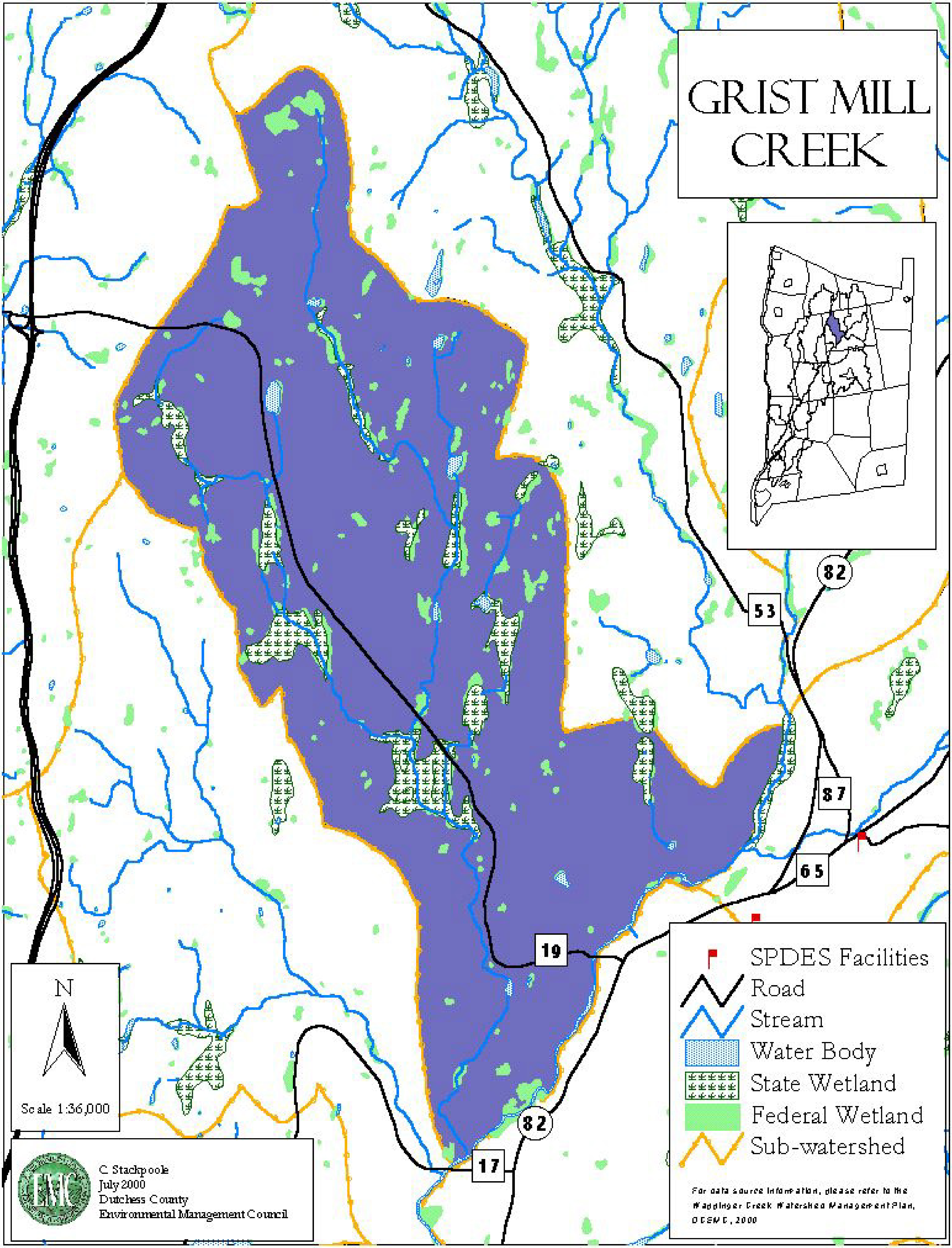
Well-drained soils are found in 77% of the subwatershed. The dominant soil types are Nassau-Cardigan complex (27%) and Dutchess-Cardigan complex (21%), well-drained soils with a moderate permeability. Water is generally available to plants in these soil types throughout the growing season, and water usually does not inhibit root growth. There may also be areas of shallow soils, sandy soils, or steep slopes within the Nassau-Cardigan complex. The Nassau and Cardigan soil series tend to be poor for septic system siting.

The NYSDEC has classified Grist Mill Creek as a class B stream (See Table 5), indicating that it is suitable for swimming and will support fish reproduction and survival. However, even though this stream is classified for swimming, the Grist Mill Creek median suspended material and fecal coliform bacteria levels exceeded the criteria developed by the EMC (Figures 4 and 6). The sources of these high levels appeared to be residential development and agriculture operations.

Median Pollutant Concentration Values (mg/L) for Grist Mill Creek

NO_3	PO_4	Suspended Solids	Fecal Coliforms
.52	.035	4.2	610

The watershed planning team recommends the protection of stream vegetative buffer zones and


GRIST MILL CREEK
82
53
87
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Scale 1:36,000
C. Stackpoole
July 2000
Dutchess County
Environmental Management Council
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000

properly designed agricultural and residential best management practices to alleviate some of the water quality impacts in the Grist Mill Creek subwatershed. Additionally, fecal coliform bacteria and phosphate levels tend to track the amount of suspended materials in the water. Knowing this, it is recommended that people do not use the Grist Mill Creek as a swimming area after large storms or whenever the creek has a high turbidity. This also means that the stream may not be meeting classifications established by the New York State Department of Environmental Conservation.

Willow Brook

The Willow Brook subwatershed encompasses 2,545 acres in the north-central portion of the Wappinger Creek watershed (Map 15). Contained entirely within the Town of Stanford, the subwatershed comprises 2% of the entire Wappinger Creek watershed. Subwatershed land use consists of 41% agriculture (the highest amount of agricultural land use of all the subwatersheds), 41% forested, 16% residential, 2% wetland and waterbodies, and .5% transportation. The stream contributes 1.6% of the total major tributary flow to the Wappinger Creek (Figure 5).

The dominant soil types in this subwatershed are Nassau-Cardigan Complex at 34% and Hoosic Gravelly Loam at 14%. These soils tend to be well drained and have a moderate to rapid permeability. Water in these soils tends to be removed rapidly, making the Hoosic Gravelly Loam poor for septic system siting. The New York State Department of Environmental Conservation has not classified Willow Brook. With no classification the stream receives minimal protection from the state.

The Willow Brook median nutrient levels exceed the criteria developed by the EMC (Figures 2 and 3). Nitrate is of particular concern with the highest median values of all the Wappinger Creek Subwatersheds (Figure 2). The nitrate contamination in Willow Brook can probably be attributed to the rapid groundwater transport of nitrate from local septic systems and cattle operations in the subwatershed (this subwatershed is fifth highest in the number of animal units – see Table 10). It is also interesting to note that this subwatershed has the smallest percentage of wetlands of all the subwatersheds (Table 8).

Median Pollutant Concentration Values (mg/L) for Willow Brook

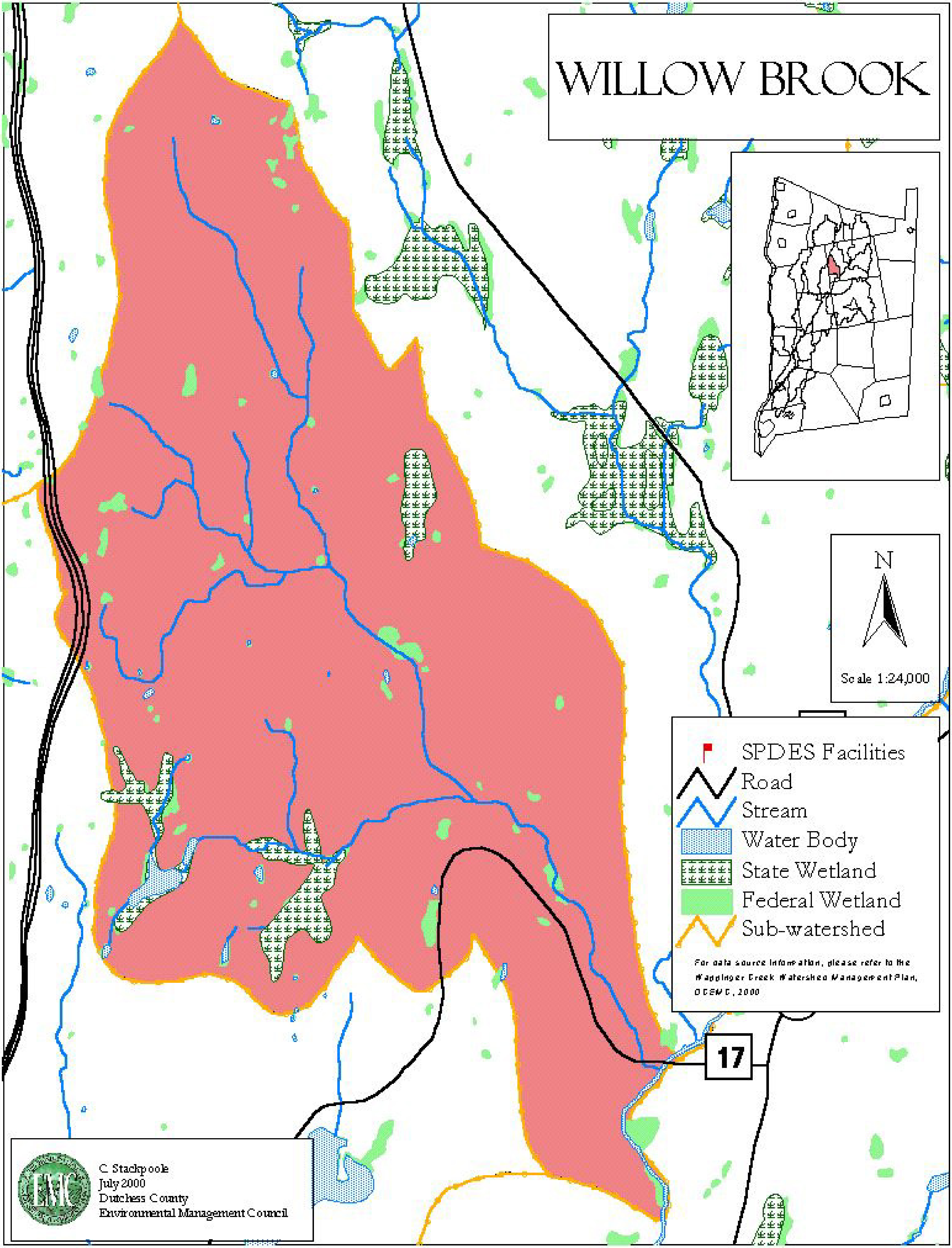
NO_3	PO_4	Suspended Solids	Fecal Coliforms
4.36	.05	3.35	30

Phosphate levels in the subwatershed were also elevated by EMC standards (Figure 3). Sources of the phosphate contamination appeared to be fertilizer applications to local agricultural fields. In addition, following rainfall events fecal coliform bacteria levels in the stream were extremely high. The most likely source of the high bacteria levels appeared to be upstream cattle operations.

Willow Brook transported high nutrient and bacteria concentrations to the Wappinger Creek in 1999. However, the brook contributes only 1.6% of the total major tributary flow to the main stem of the Wappinger Creek. The low contribution of flow from this tributary lessened the impact of the high nutrient and bacteria concentrations that were entering the main stem of the Wappinger Creek. The watershed planning team strongly recommends proper septic system siting and maintenance, increased stream vegetative buffers, and properly designed agricultural best management practices to help alleviate some of the impacts to water quality in the Willow Brook subwatershed.

Tamarack Swamp Creek

The Tamarack Swamp Creek subwatershed encompasses 8,392 acres in the northeastern portion of the Wappinger Creek watershed (Map 16). Contained within the Towns of Stanford and Washington, this subwatershed comprises 6% of the entire Wappinger Creek watershed. Subwatershed land uses consist of 23% agriculture, 62% forested (second-highest


WILLOW BROOK
N
Scale 1:24,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
17
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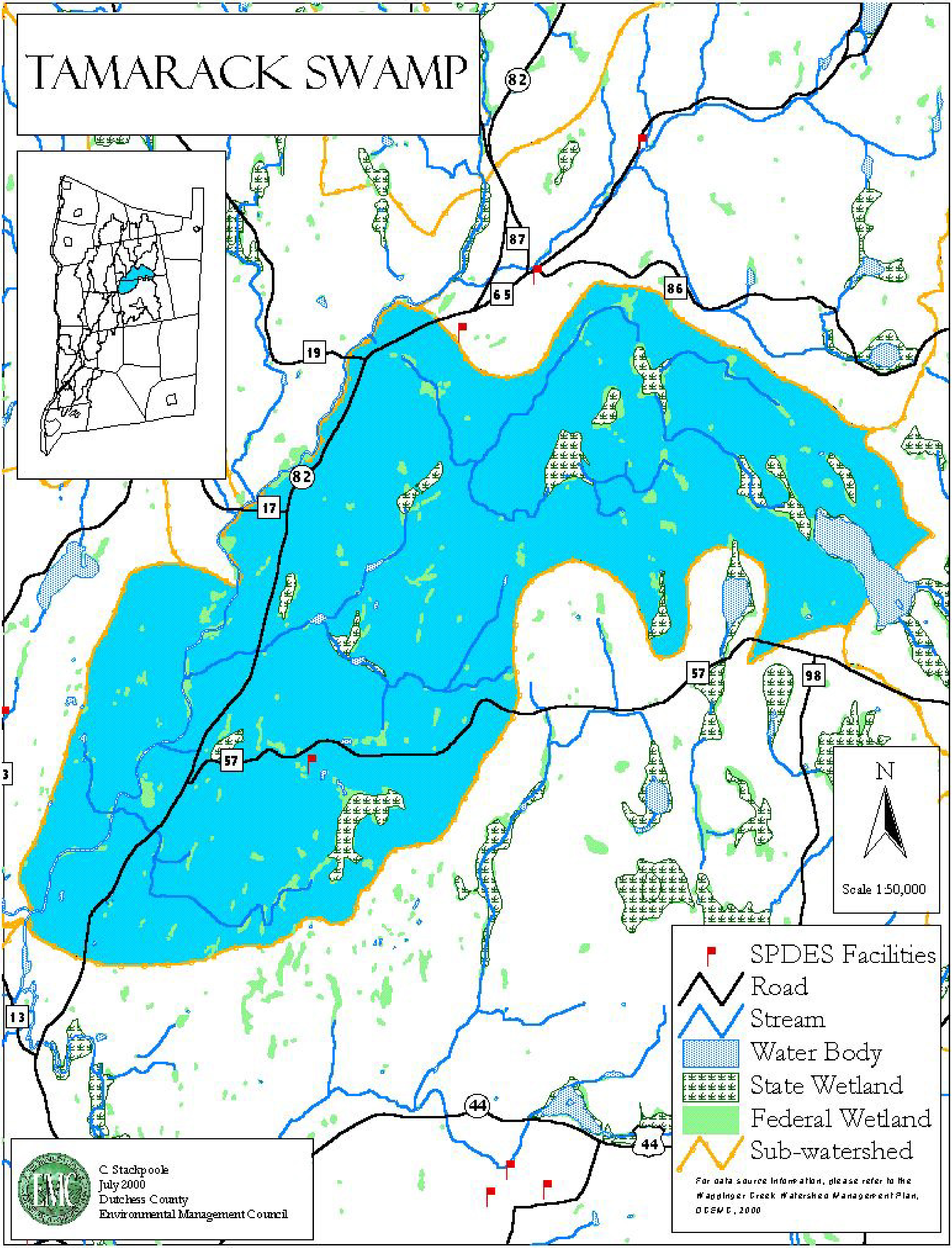
July 2000
Dutchess County
Environmental Management Council


TAMARACK SWAMP
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SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
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Dutchess County
Environmental Management Council

among all subwatersheds-see Table 8), 8% residential, 5% wetland and waterbodies, 2% sand and gravel mining, .4% public land, and .01% communication. The stream contributes 2.2% of the total major tributary flow to the Wappinger Creek (Figure 5).

Well-drained to excessively drained soils are found in 83% of the Tamarack Creek subwatershed. The dominant soil types are Nassau-Cardigan complex at 41%, Dutchess-Cardigan complex at 17% and Hoosic gravelly loam at 16%. These soils tend to be well drained and have a moderate permeability. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth. Some of the Nassau-Cardigan complex and Hoosic gravelly loam soils are excessively drained due to shallow soils, sandy soils, or steep slopes, and are poor for septic system siting.

The New York State Department of Environmental Conservation (NYSDEC) has classified Tamarack Swamp Creek as a class B, B(t), C(t), and C(ts) stream (see Table 5). The best usages of class B waters are swimming and fishing. The best usages of the Class C(t) and C(ts) waters are fishing. All of the waters in this subwatershed should support fish reproduction and survival, and some should support trout and trout reproduction.

The headwaters of Tamarack Swamp Creek discharge from Bontecou Lake. 123 acres in size, this lake has not been classified by the NYSDEC. Bontecou Lake is unique in that it is the watershed divide between the Wappinger Creek Watershed and the Tenmile River Watershed, discharging water both east and west to the Wappinger Creek and Tenmile River, respectively. The watershed divide is at an undetermined point in Bontecou Lake, explaining the fact that this subwatershed is the sixth largest but contributes only 2.2% of the total major tributary flow to the Wappinger Creek.

The Tamarack Swamp Creek median nitrate, phosphate, fecal coliform bacteria, and suspended material concentrations in 1999 existed below the thresholds developed by the EMC (Figures 2, 3, 4 and 6). However, concentrations are approaching the DCEMC thresholds and the thresholds for pristine aquatic systems. Additionally, following storm events fecal coliform bacteria levels are much higher than the DCDOH standards for swimming.

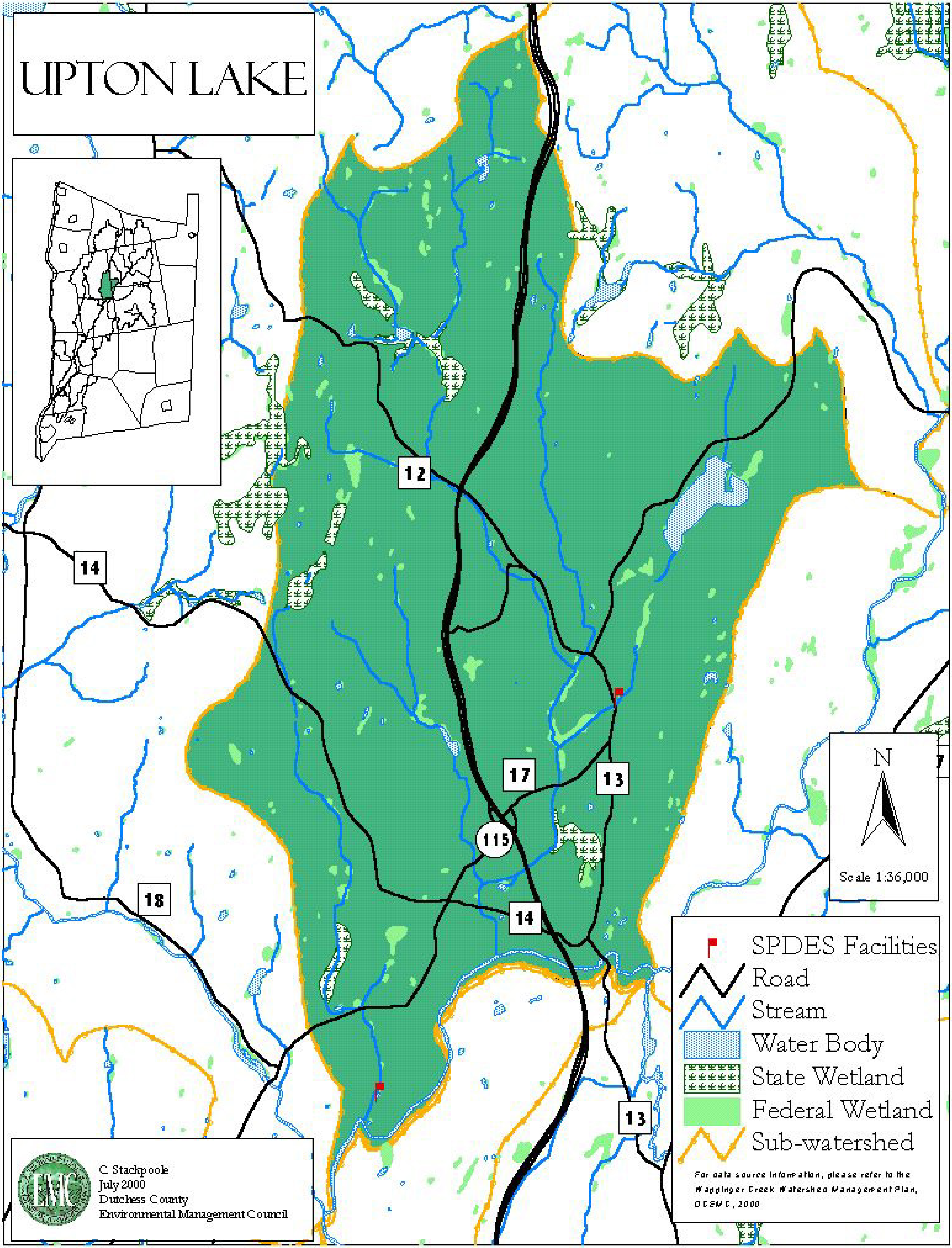
Median Pollutant Concentration Values (mg/L) for Tamarack Swamp Creek

NO_3	PO_4	Suspended Solids	Fecal Coliforms
1.07	.044	3.07	520

The relatively low pollutant levels in the watershed can probably be attributed to the high amount of forested land use and possibly existing best management practices on subwatershed agricultural operations (note that this subwatershed has the fourth largest number of animal units of all subwatersheds). Threats to the good subwatershed health include destruction of stream vegetative buffer zones, poor septic system siting, and residential and agricultural development without proper planning and employment of best management practices.

Upton Lake Creek

The Upton Lake Creek subwatershed encompasses 5,523 acres in the north-central portion of the Wappinger Creek watershed (Map 17). Contained within the Towns of Stanford, Clinton, and Pleasant Valley, the subwatershed comprises 4% of the entire Wappinger Creek watershed. Subwatershed land uses consist of 29% agriculture (third highest among all subwatersheds-see Table 8), 42% forested, 18% residential, 3% wetland and waterbodies, 1.5% transportation and communication, .33% commercial strip, and .1% public land. The stream contributes 3.6% of the total major tributary flow to the Wappinger Creek (Figure 5). Some local residents also know Upton Lake Creek as Clinton Corners Brook. The dominant soil types in the subwatershed are Nassau-Cardigan complex at 34%, Dutchess-Cardigan complex at 17% and Bernardston silt loam at 9%.


UPTON LAKE
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Scale 1:36,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
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July 2000
Dutchess County
Environmental Management Council

These soils tend to be well drained and have a moderate permeability, making them poor for septic system siting. Water is generally available to plants throughout the growing season and water usually doesn't inhibit root growth. Some of the Nassau-Cardigan complex soils are excessively drained due to shallow soils, sandy soils, or steep slopes.

The New York State Department of Environmental Conservation (NYSDEC) has classified Upton Lake Creek as a class B and C(ts) stream. The best usages of class B waters are swimming and fishing. These waters will also support fish reproduction and survival. The best usages of the Class C(ts) waters are fishing, and the waters support fish propagation and survival. Upton Lake Creek should support trout populations and propagation.

43-acre Upton Lake is located in the center of this subwatershed. Designated class B by the NYSDEC, this lake is surrounded by residential land use. Although this lake is classified for swimming, the lake has been listed on the NYSDEC priority water list as stressed by excess nutrients. Excess aquatic vegetation in the summer months impairs swimming, and is an indication of excess nutrient loading into the lake. The nutrient loading can probably be attributed to on-site septic systems and fertilizer applications to lakeside property.

The Upton Lake Creek median nitrate levels exceeded the criteria developed by the EMC (Figure 2). These high levels can probably be attributed to poorly planned residential fertilizer applications, agricultural operations, and the rapid groundwater transport of nitrate from local septic systems. There were several sites in the Upton Lake Creek drainage where the stream vegetative buffer zone was being destroyed. The destruction of this vegetated buffer zone will increase sediment and nutrient loading to the stream, warm water temperatures, and threaten the ability of aquatic life to reproduce. Also, this subwatershed has the third-lowest percentage of wetlands compared to all sixteen subwatersheds (Table 8). Therefore, there is little natural capacity to absorb nitrate through plant uptake in wetlands.

Median Pollutant Concentration Values (mg/L) for Upton Lake Creek

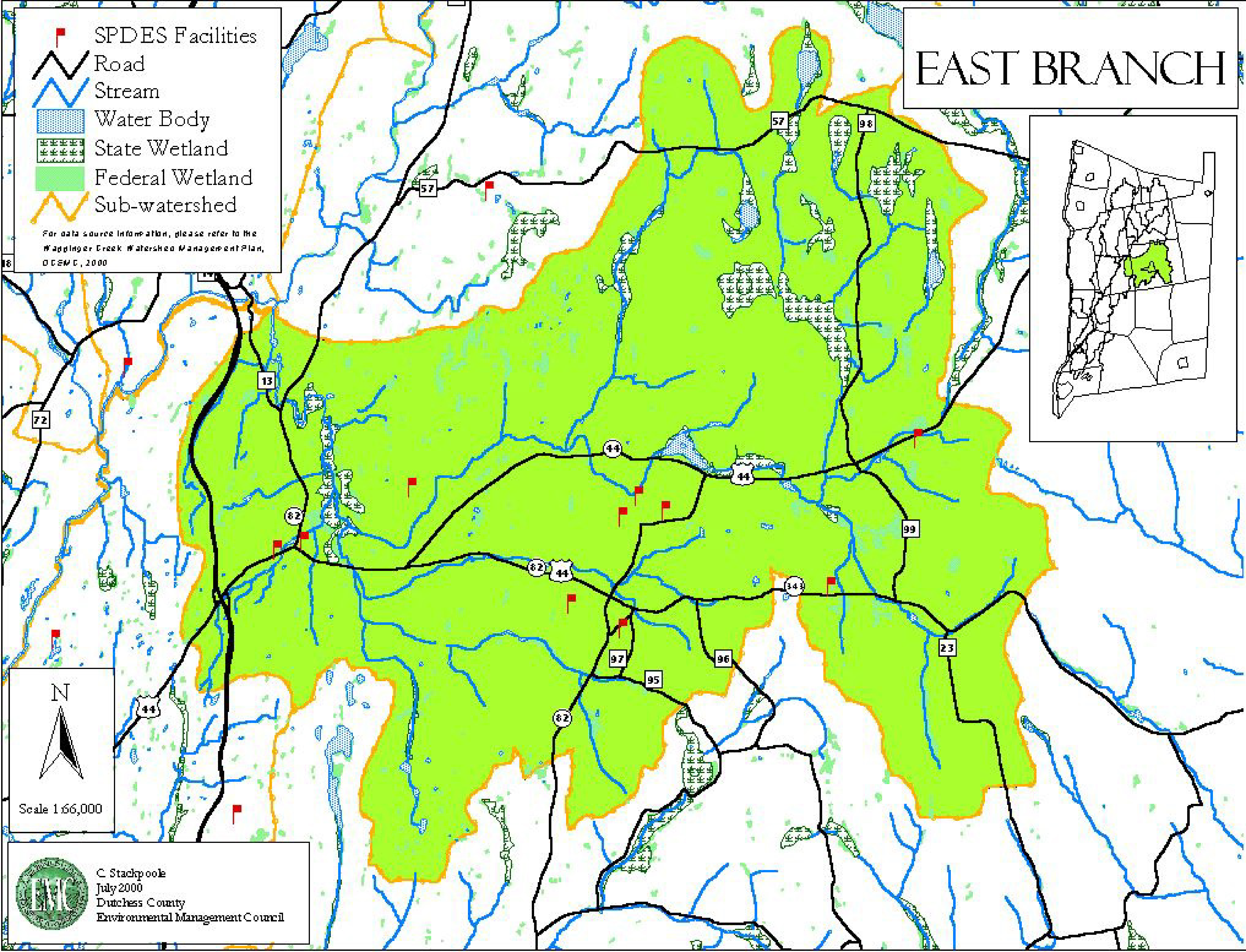
NO_3	PO_4	Suspended Solids	Fecal Coliforms
2.01	.036	3.1	230

Upton Lake Creek transported relatively high nitrate concentrations to the Wappinger Creek in 1999. The watershed planning team recommends the protection of stream vegetative buffer zones, wetland protection, proper septic system siting and maintenance, and properly designed agricultural and residential best management practices to help alleviate some of the water quality impacts in the Upton Lake Creek subwatershed.

East Branch Wappinger Creek

The largest of all the drainage basins, the East Branch subwatershed encompasses 21,387 acres in the eastern portion of the Wappinger Creek watershed (Map 18). Contained within the Towns of Washington, Stanford, Clinton, and the Village of Millbrook the subwatershed comprises 16% of the entire Wappinger Creek watershed. Subwatershed land uses consist of 29% agriculture, 55% forested, 8% residential, 5% wetland and waterbodies, .3% transportation and communication, .6% gravel mining, .4% commercial strip and urban, and 2% public land and outdoor recreation. The stream contributes 17% of the total major tributary flow to the Wappinger Creek (Figure 5).

Excessively drained and well-drained soils are found in 78% of the East Branch subwatershed. The dominant soil types are Nassau-Cardigan complex at 27% and Dutchess-Cardigan complex at 18%. These soils tend to be well drained and have a moderate permeability, making them poor for septic system siting. Some of the Nassau-Cardigan complex soils are excessively drained due to shallow soils, sandy soils, or steep slopes. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth.


EAST BRANCH
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
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Scale 1:66,000
C. Stackpoole
July 2000
Dutchess County
Environmental Management Council
EMC
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The East Branch begins at the confluence of Shaw Brook and Mill Brook west of the Village of Millbrook. These two smaller streams are classified as class A(t), meaning that they are suitable for drinking when filtered and disinfected (see Table 5). The Village of Millbrook groundwater wells are located at the confluence of these two streams. The classifications of the East Branch below the Village change from A(t), to B, to B(t) and finally to C(t) at the confluence with Wappinger Creek.

The East Branch of Wappinger Creek median phosphate and suspended material concentrations exceeded the criteria developed by the EMC (Figures 3 and 4). The sources of these high levels appeared to be sewage treatment plant effluent, septic systems, residential fertilizer applications, and possibly agriculture operations. Notably, this subwatershed contains the highest number of animal units (Table 10) and the fourth highest number of SPDES discharge permits (Table 9) among all subwatersheds. Both of these land uses may contribute high levels of nutrients to adjacent waterbodies. Disturbance from residential development and the repair of the Dieterich Pond dam may also have released phosphorous stored in sediment from past land uses.

Median Pollutant Concentration Values (mg/L) for East Branch Wappinger Creek

NO_3	PO_4	Suspended Solids	Fecal Coliforms
1.21	.047	5.73	295

The East Branch transported relatively high phosphate concentrations, and the second highest suspended material concentrations to the Wappinger Creek in 1999. The watershed planning team recommends proper septic system siting and maintenance, and properly designed agricultural and residential best management practices to help alleviate some of the water quality impacts in the East Branch. Also, the destruction of the stream's vegetated buffer zone increases sediment and nutrient loading to the stream, warm water temperatures, and threatens the ability of aquatic life to reproduce. Therefore, it should be a priority to protect the stream's natural vegetated buffer zone.

Great Spring Creek

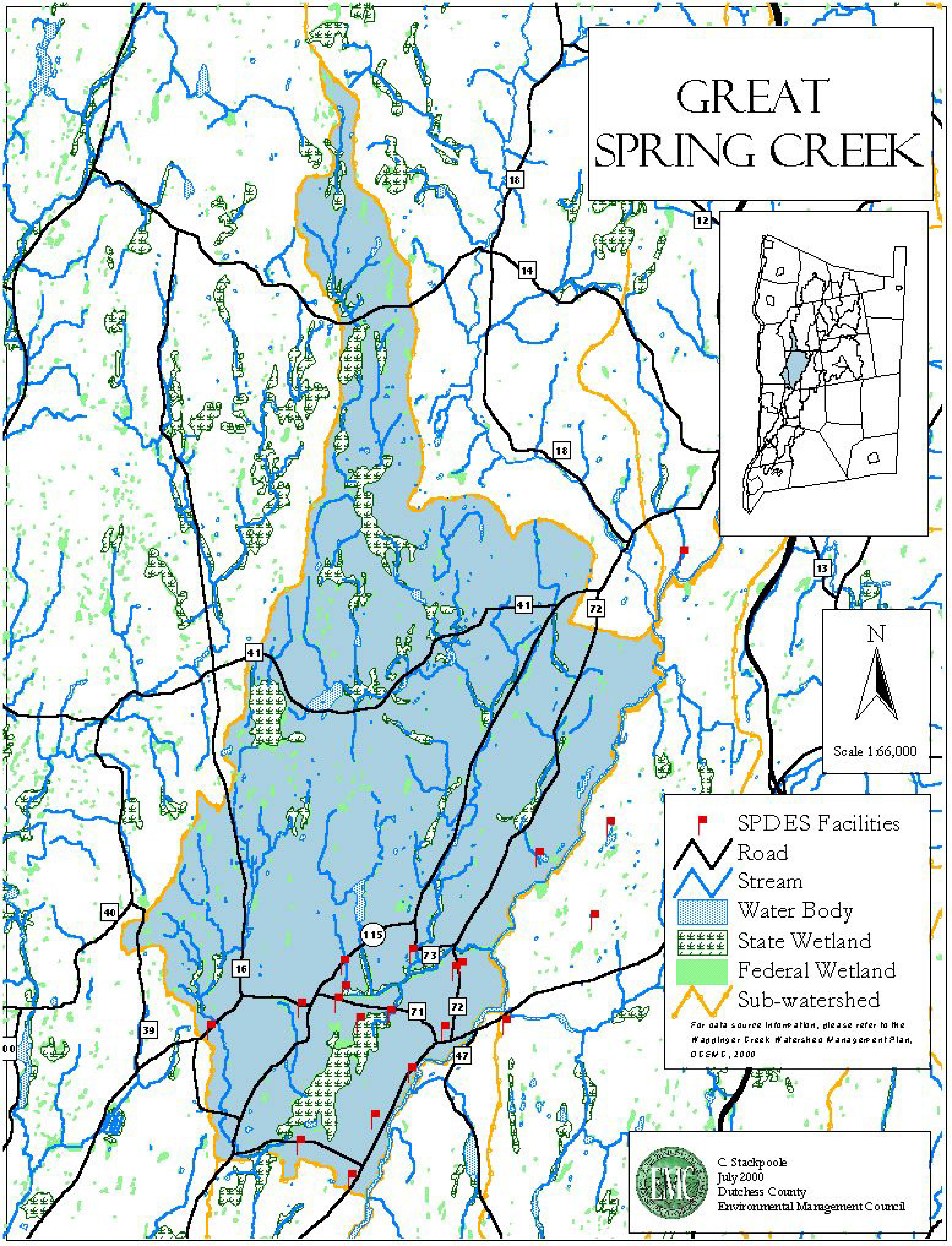
The Great Spring Creek subwatershed encompasses 12,068 acres in the central portion of the Wappinger Creek watershed (Map 19). Contained within the Towns of Clinton, Hyde Park, Poughkeepsie, and Pleasant Valley, this subwatershed is the third largest and comprises 9% of the entire Wappinger Creek watershed. Subwatershed land uses consist of 32% agriculture, 38% forested, 20% residential, 7% wetland and waterbodies, 1.5% transportation and communication, .42% commercial strip, .8% stone quarries, and .6% public land and outdoor recreation. The stream contributes 5.4% of the total major tributary flow to the Wappinger Creek (Figure 5).

Well-drained soils are found in 78% of the subwatershed. The dominant soil types are Dutchess-Cardigan complex at 29% and Nassau-Cardigan complex at 19%. These soils tend to be well drained and have a moderate permeability, making them poor for septic system siting. Some of the Nassau-Cardigan complex soils are excessively drained due to shallow soils, sandy soils, or steep slopes. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth.

Median Pollutant Concentration Values (mg/L) for Great Spring Creek

NO_3	PO_4	Suspended Solids	Fecal Coliforms
1.8	.05	4.5	1210

The New York State Department of Environmental Conservation (NYSDEC) has classified Great Spring Creek as a class B stream (see Table 5), indicating that it is suitable for swimming, fishing and fish survival. However, even though this stream is classified for swimming, the median nitrate, phosphate, suspended material, and fecal coliform bacteria concentrations exceeded the criteria developed by the EMC (Figures 2, 3, 4 and 6). Fecal coliform bacteria levels were also higher than


GREAT
SPRING CREEK
N
Scale 1:66,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
C. Stackpoole
July 2000
Dutchess County
Environmental Management Council
EMC
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the standard set by the DCDOH for swimming areas. In fact, fecal coliform bacteria median concentrations were the highest of any of the subwatersheds.

Elevated nutrient levels in Great Spring Creek can probably be attributed to rapid groundwater transport of nitrate from local septic systems, poorly planned residential fertilizer applications, and possibly agricultural operations. This subwatershed is the third highest in the number of animal units when compared to all subwatersheds (Table 10). Also, the number of SPDES discharge locations is the second highest in the watershed (Table 9). Both of these land uses may contribute high levels of nutrients to adjacent waterbodies. High suspended material concentrations were most likely caused by road runoff, poorly planned residential development, and clearing of the vegetated buffer zone along the stream. Even though this subwatershed is the fourth highest in the percentage of wetland area (Table 8), the capacity of the wetlands to filter nutrients, sediment and bacteria may be exhausted.

Great Spring Creek transported relatively high concentrations of all tested parameters to the Wappinger Creek in 1999. The watershed planning team recommends the protection of stream vegetative buffer zones, proper septic system siting and maintenance, and properly designed agricultural and residential best management practices to help alleviate some of the water quality impacts in the Great Spring Creek subwatershed.

Pleasant Valley East

The Pleasant Valley East Creek subwatershed encompasses 8,967 acres in the central portion of the Wappinger Creek watershed (Map 20). Contained within the Towns of Pleasant Valley and LaGrange, the subwatershed comprises 7% of the entire Wappinger Creek watershed. Subwatershed land use consists of 10% agriculture, 58% forested (fourth highest among all subwatersheds), 24% residential, 5% wetland and waterbodies, 1.3% transportation and communication, .07 gravel mining, .36% commercial strip, and .4% public land and outdoor recreation. The stream contributes 7.1% of the total major tributary flow to the Wappinger Creek (Figure 5).

Excessively drained and well-drained soils are found in 87% of the Pleasant Valley East subwatershed. The dominant soil types are Nassau-Cardigan complex at 61% and Dutchess-Cardigan complex at 18%. These soils tend to be well drained and have a moderate permeability, making them poor for septic system siting. Some of the Nassau-Cardigan complex soils are excessively drained due to shallow soils, sandy soils, or steep slopes. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth.

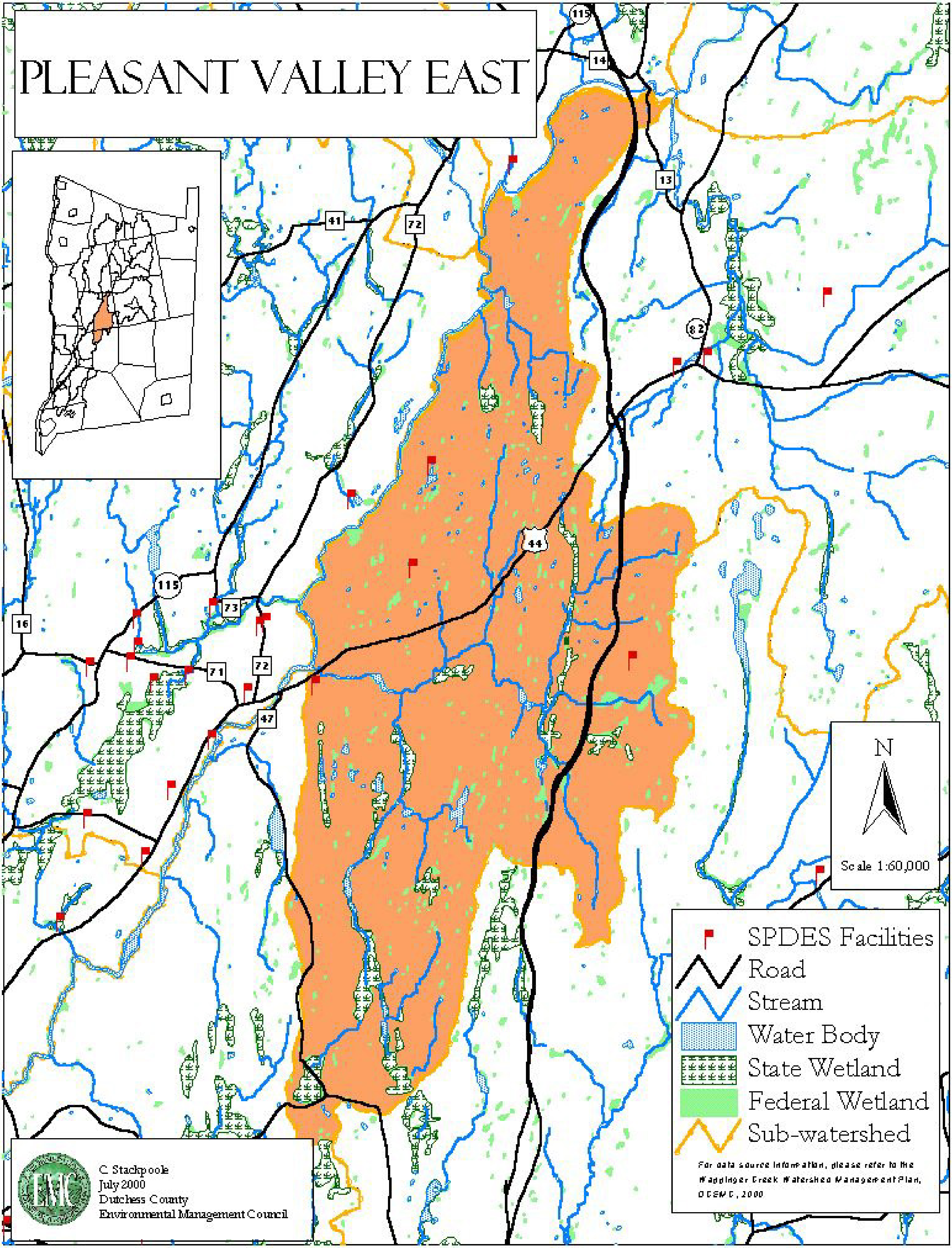
The New York State Department of Environmental Conservation has classified Pleasant Valley East Creek as a class B and B(t) stream (see Table 5), making it suitable for swimming and fishing. The stream should also support fish reproduction and survival and portions may support trout.

The Pleasant Valley East Creek median phosphate and suspended material levels exceeded the criteria developed by the EMC (Figures 3 and 4). The sources of these high levels appeared to be residential development, septic systems, residential fertilizer applications, and possibly agriculture operations. Additionally, current residential development may be releasing phosphate stored in soils that once supported agricultural land uses.

Median Pollutant Concentration Values (mg/L) for Pleasant Valley East Creek

NO_3	PO_4	Suspended Solids	Fecal Coliforms
.84	.08	5.8	385

Even though the Pleasant Valley East subwatershed has a high proportion of forested land use, this tributary transported the highest concentrations of phosphate and suspended materials to the Wappinger Creek out of all sixteen subwatersheds in 1999. The watershed planning team recommends proper septic system siting and maintenance and properly designed


PLEASANT VALLEY EAST
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Scale 1:60,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
EMC
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July 2000
Dutchess County
Environmental Management Council

agricultural and residential best management practices to help alleviate some of the water quality impacts in the Pleasant Valley East Creek subwatershed. Also, the destruction of vegetated buffer zones increases sediment and nutrient loading to the stream, warms water temperatures, and threatens the ability of aquatic life to reproduce. Therefore, maintaining a naturally vegetated buffer zone to the stream should be a priority in this subwatershed.

Overlook Road Subwatershed

The Overlook Road subwatershed encompasses 6,792 acres in the south-central portion of the Wappinger Creek watershed (Map 21). Contained within the Towns of LaGrange and Pleasant Valley, the subwatershed comprises 5% of the entire Wappinger Creek watershed. Subwatershed land uses consist of 19% agriculture, 42% forested, 27% residential, 5% wetland and waterbodies, 2% transportation and communication, 4% commercial, and .7% public land and outdoor recreation.

Well-drained soils can be found in 66% of the Overlook Road subwatershed. The dominant soil types are Dutchess-Cardigan complex at 25%, Nassau-Cardigan complex at 15% and Bernardston silt loam at 11%. These soils tend to be well drained and have a moderate permeability, making them poor for septic system siting. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth.

The Overlook Road subwatershed consists of five smaller streams that discharge directly into the Wappinger Creek. The NYSDEC has given these streams various classifications ranging from B to D, although only one headwater section is classified as B (see Table 5 on page 14 for a description of the classifications). While class B waters are suitable for swimming, the only use recommended for class D waters is fishing, and there is minimal protection for class D waterways.

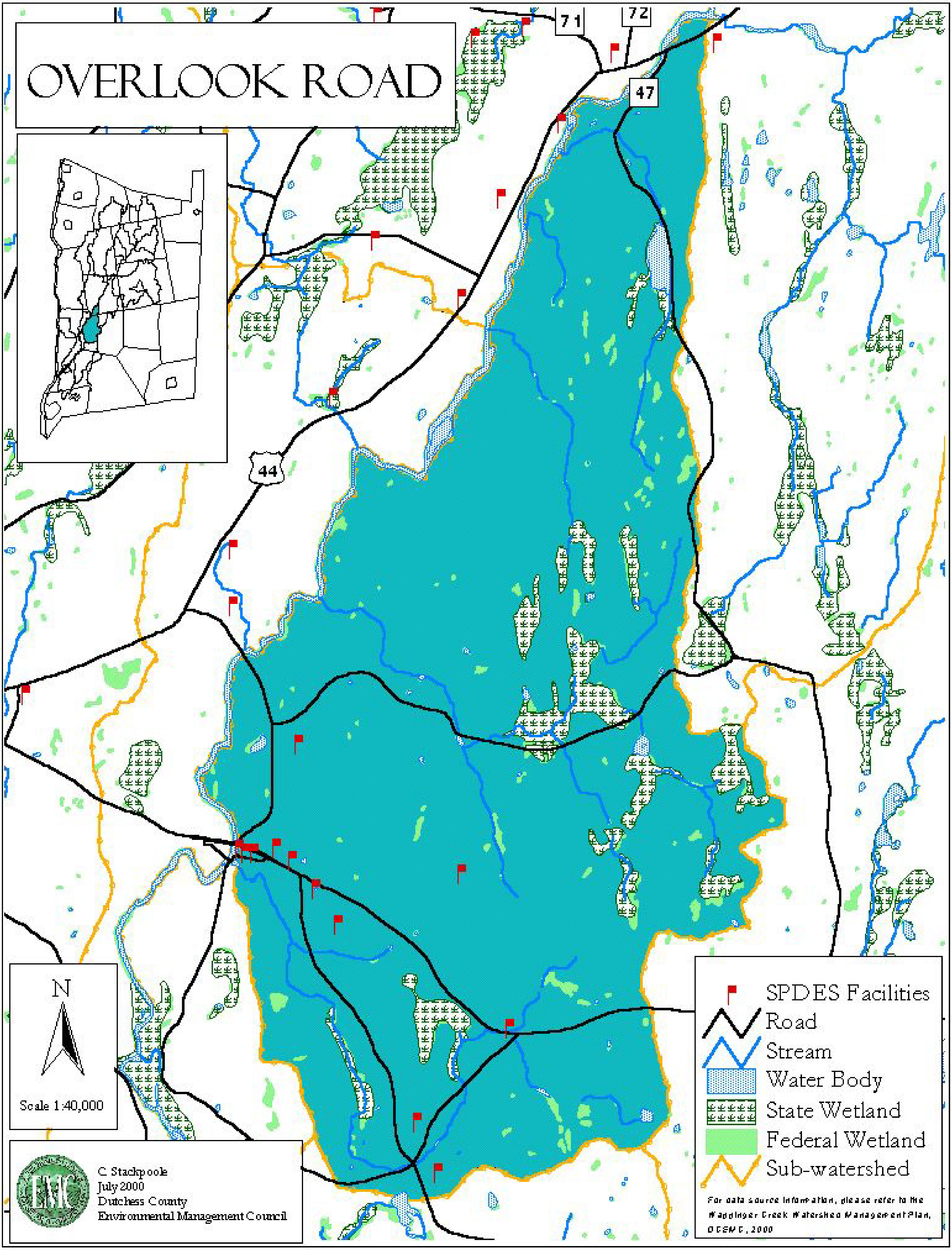
Due to the scattered locations of the streams in the Overlook Road subwatershed the DCEMC did not have a stream sampling point in these tributaries, therefore pollutant loading cannot be determined. However, Table 9 indicates that this subwatershed has the third highest number of SPDES discharge points in the Wappinger Creek Watershed, and therefore may be contributing fairly high levels of nutrients to Wappinger Creek.

The varied land use in the subwatershed indicates a variety of best management practices can be employed to improve or maintain current water quality. The watershed planning team recommends that creation or maintenance of storm water runoff devices, proper septic system siting and maintenance, and properly designed residential and agricultural best management practices be implemented to help alleviate some of the potential water quality impacts in this subwatershed. Also, the destruction of the stream's vegetated buffer zone will increase sediment and nutrient loading to the stream, warm water temperatures, and threaten the ability of aquatic life to reproduce. Therefore, it should be a priority to protect or restore the natural vegetated buffer zone along the stream.

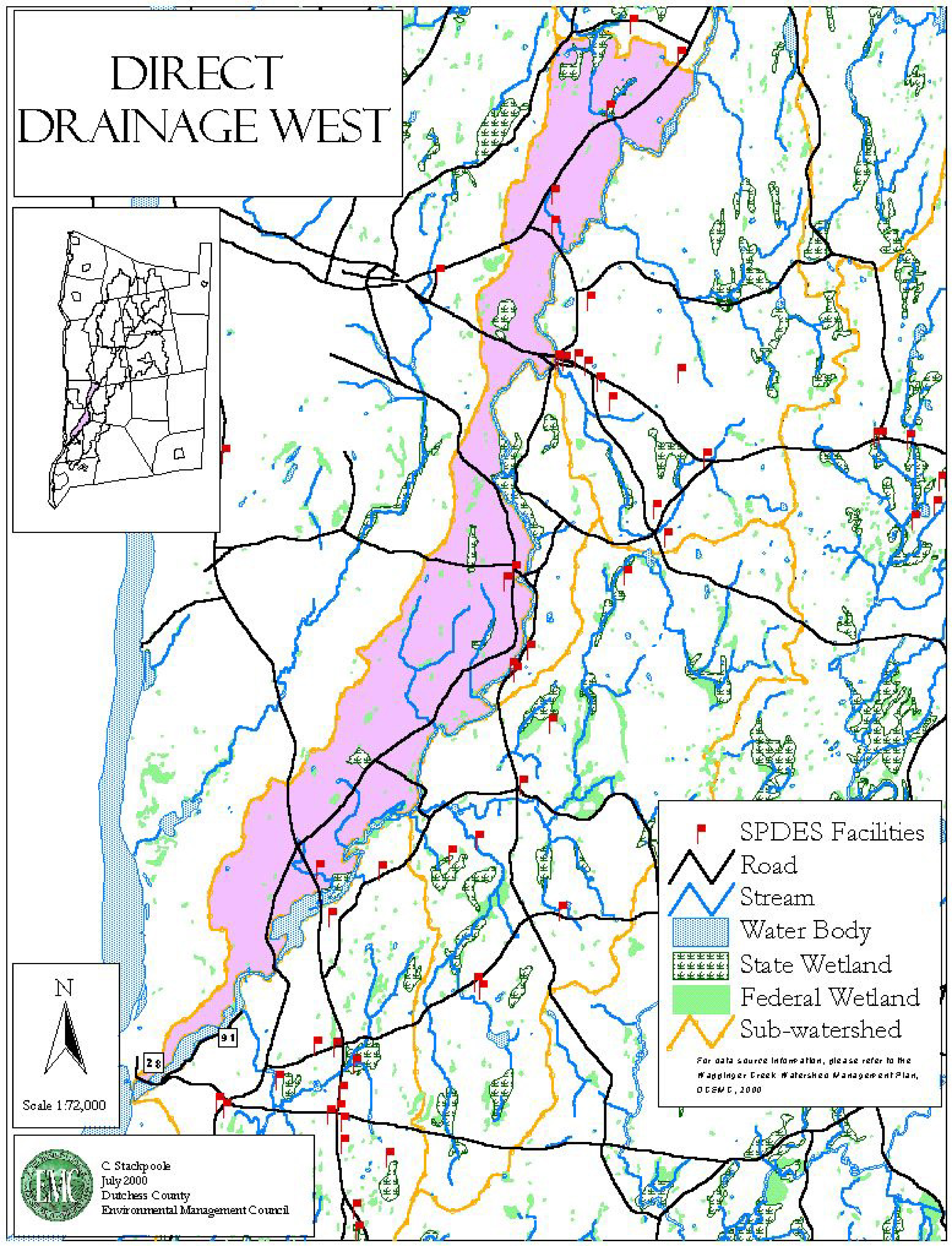
Direct Drainage West Subwatershed

The Direct Drainage West subwatershed encompasses 5,369 acres in the southern portion of the Wappinger Creek watershed (Map 22). Contained within the Town of Poughkeepsie and the Village of Wappingers Falls, this subwatershed comprises 4% of the entire Wappinger Creek watershed. Direct Drainage West has the highest percentage of residential land use (53%) of all the subwatersheds (Table 8). Other land uses include 28% forested, 2% agriculture, 4% wetland and waterbodies, .04% transportation and communication, 8% commercial and light manufacturing, 4% public land and outdoor recreation, and .08% gravel mining.

Well-drained soils are found in 77% of this subwatershed. The dominant soil types are Galway-Farmington complex at 18%, Hoosic gravelly loam at 15% and Dutchess-Cardigan complex at 10%. The Dutchess-Cardigan



Overlook Road
71
72
47
44
N
Scale 1:40,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
EMC
C. Stackpoole
July 2000
Dutchess County
Environmental Management Council


Direct Drainage West
N
Scale 1:72,000
91
28
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the
Wappinger Creek Watershed Management Plan,
DCEMC, 2000
EMC
C. Stackpoole
July 2000
Dutchess County
Environmental Management Council

complex and Galway-Farmington complex tend to be well drained and have a moderate permeability. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth. Hoosic Gravelly Loam tends to be excessively drained, has a rapid permeability, and water tends to be removed quickly due to sandy soils, shallow soils, or steep slopes. The Hoosic, Galway, Farmington, and Cardigan soil series are all poor for septic system siting due to their high permeability.

The Direct Drainage West subwatershed consists of six smaller streams that discharge directly into the Wappinger Creek. The New York State Department of Environmental Conservation (NYSDEC) has classified five of the tributaries as class D streams (see Table 5), and one as an unclassified stream. The best usage for class D waters is fishing, and there is minimal protection for class D waterways.

Due to the scattered locations of the streams in this subwatershed the EMC did not have a stream sampling point in these tributaries, therefore pollutant loading cannot be determined. However, the fact that a majority of the tributaries are classified as D waters indicates poor or undetermined water quality in this subwatershed. Creation or maintenance of storm water runoff devices, proper septic system siting and maintenance, and properly designed residential best management practices should be employed to help alleviate some of the potential water quality impacts in this subwatershed. Also, the destruction of the vegetated buffer zone along these smaller streams will increase sediment and nutrient loading, warm water temperatures, and threaten the ability of aquatic life to reproduce. Therefore, it should be a priority to protect or restore natural vegetated buffer zones along the streams.

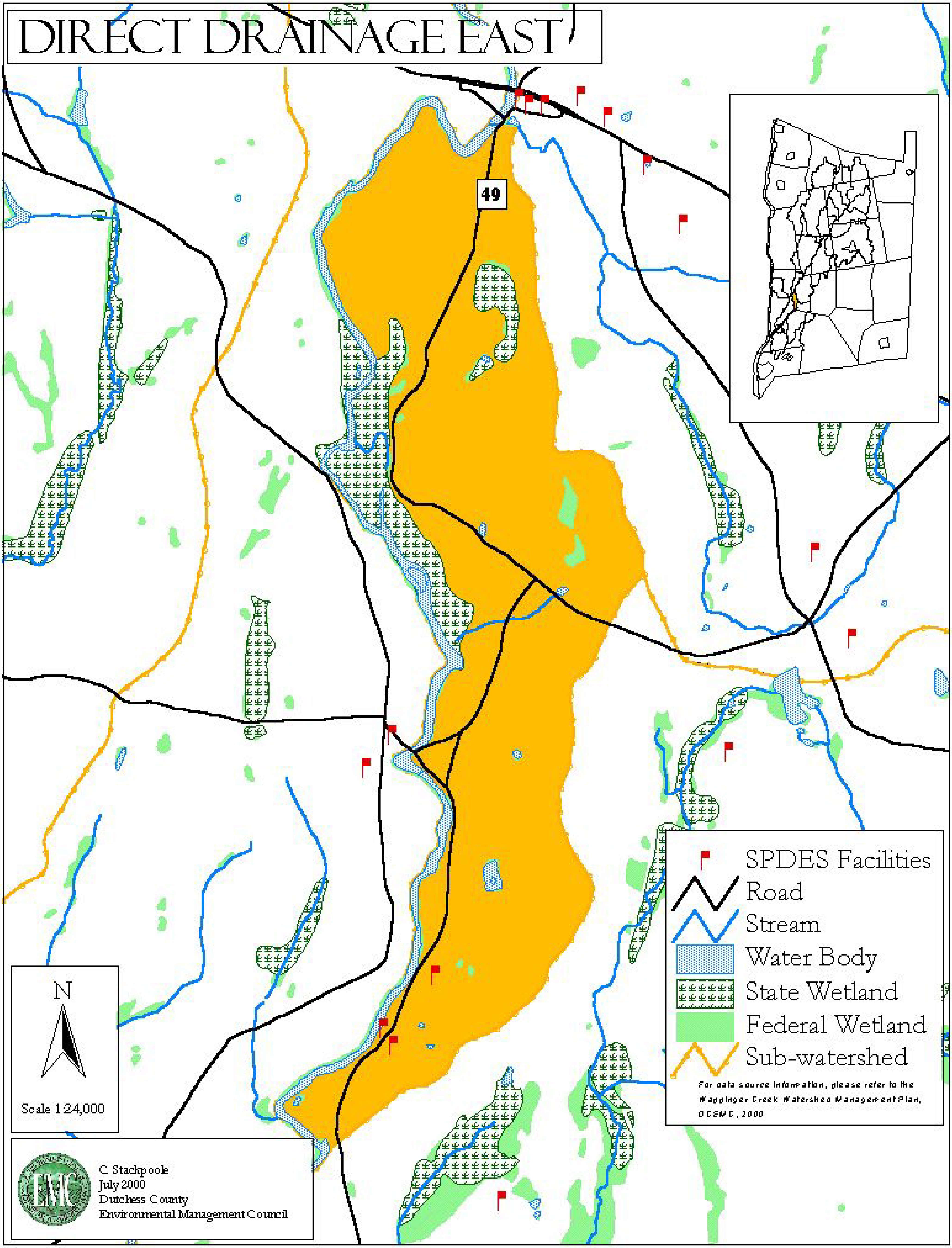
Direct Drainage East Subwatershed

The Direct Drainage East subwatershed encompasses 1,099 acres in the south-central portion of the Wappinger Creek watershed. Contained within the Town LaGrange, the subwatershed comprises 1% of the entire Wappinger Creek watershed. Subwatershed land uses consist of 19% agriculture, 23% forested, 45% residential (the second-highest among all subwatersheds), 8% wetland and waterbodies, 1% commercial and shopping center, and 2% public land and outdoor recreation.

Well-drained soils can be found in 80% of this subwatershed. The dominant soil types are Hoosic gravelly loam at 25% and Bernardston silt loam at 20%. The Bernardston silt loam tends to be well drained and have a moderate permeability. With this soil type water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth. Hoosic Gravelly Loam tends to be somewhat excessively drained, have a rapid permeability, and water tends to be removed quickly due to sandy soils, shallow soils, or steep slopes. Due to the rapid permeability the Hoosic and Bernardston soil series are poor for septic system siting.

The Direct Drainage East subwatershed contains two smaller streams that discharge directly into the Wappinger Creek. The NYSDEC has classified one of the tributaries as class B(t) stream (see Table 5), and the other is an unclassified stream. The best usages of class B waters are swimming and fishing, and these waters will also support fish reproduction. Additionally, the stream should support trout populations, but not reproduction. The remainder of the subwatershed consists of direct runoff to the Wappinger Creek from the adjacent land.

Due to the scattered locations of the streams in this subwatershed the EMC did not have a sampling point in this drainage basin, therefore pollutant loading cannot be determined. Interestingly, Direct Drainage East has the third largest percentage of wetlands compared with all subwatersheds, suggesting that there may be some natural filtration of surface water occurring in the wetlands. However, the wetland filtering study (see Chapter III) has shown that residential wetlands in the Wappinger Creek Watershed may have reached their capacity to filter pollutants.



DIRECT DRAINAGE EAST
49
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
N
Scale 1:24,000
EMC
C. Stackpoole
July 2000
Dutchess County
Environmental Management Council

The watershed planning team recommends that creation or maintenance of storm water runoff devices, proper septic system siting and maintenance, and properly designed residential best management practices be implemented to help alleviate some of the potential water quality impacts in this subwatershed. Also, the destruction of vegetated buffer zones along the tributaries increases sediment and nutrient loading, warms water temperatures, and threatens the ability of aquatic life to reproduce. Therefore, it should be a priority to protect or restore the natural vegetated buffer zone along these smaller streams.

Dutchess County Airport

The Dutchess County Airport subwatershed encompasses 7,888 acres in the southern portion of the Wappinger Creek watershed (Map 24). Contained within the Towns of LaGrange, Wappinger, and the Village of Wappingers Falls, the subwatershed comprises 6% of the entire Wappinger Creek watershed. Subwatershed land uses consist of 15% agriculture, 35% forested, 36% residential (the fourth largest among all subwatersheds-see Table 8), 6% wetland and waterbodies, 5% transportation and communication, 2% commercial strip and light manufacturing, and 1% public land. The stream contributes 5% of the total major tributary flow to the Wappinger Creek.

The dominant soil types in the subwatershed are Dutchess-Cardigan complex at 25%, Bernardston silt loam at 24% and Canandaigua silt loam at 11%. The Dutchess-Cardigan complex and Bernardston silt loam tend to be well drained and have a moderate permeability. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth. The Canandaigua silt loam is a hydric soil that is poorly drained and has a moderately slow permeability. The Canandaigua, Bernardston, and Cardigan soil series are not suitable for septic system siting.

The Dutchess County Airport Creek originates from Greens Pond (a class D waterbody – see Table 5). The Creek below Greens Pond is a class C stream, meaning that it is suitable for fishing and boating. Two tributaries form Greens Pond. The tributary flowing in from the east is classified as a class B, B(t), and C(t) stream, and the stream flowing in from the south is classified as a class D stream. While class D waters are suitable for fishing, there is minimal protection for this classification and fish will probably not reproduce here.

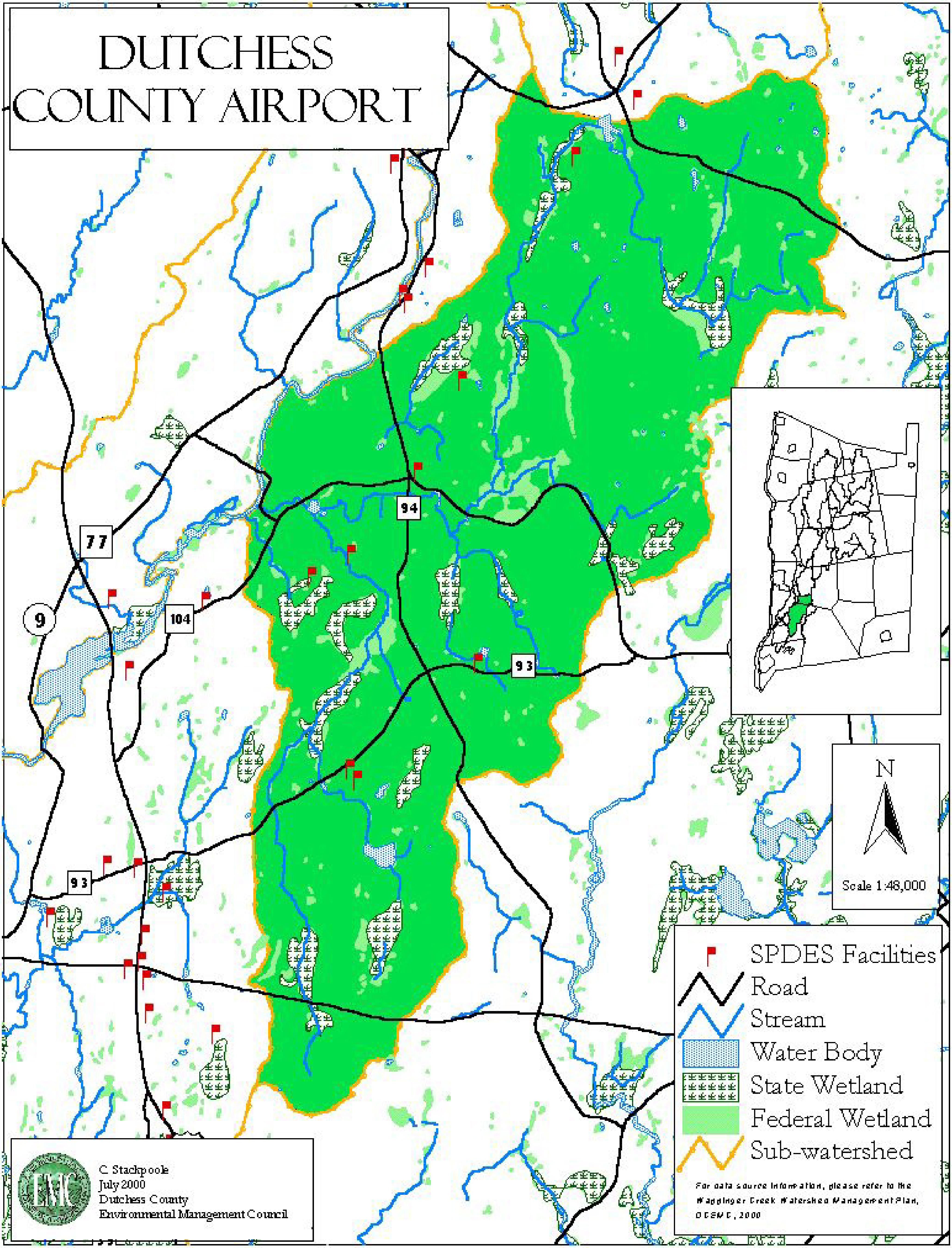
The Dutchess County Airport Creek median nitrate, suspended material, and fecal coliform bacteria concentrations exceeded the criteria developed by the EMC (Figures 2, 3 and 6). The sources of these high levels appeared to be septic systems, road runoff, residential fertilizer applications, and residential development. The nitrate contamination could probably be attributed to the rapid groundwater transport of nitrate from local septic systems, runoff from residential lawn applications, and possibly groundwater movement from two large landfills underneath the Airport property. Road runoff and residential development probably accounted for the majority of the suspended material.

Median Pollutant Concentration Values (mg/L) for the Dutchess County Airport Tributary

NO_3	PO_4	Suspended Solids	Fecal Coliforms
2.09	.08	5.0	640

Greens Pond should have acted as sediment trap for the suspended material before it entered the Wappinger Creek. However, even with the pond in place, elevated levels of nitrate, suspended material, and fecal coliform bacteria were being transported to the Wappinger Creek. Also, public water supplies in this area have shown nitrate levels exceeding the drinking water standard in the past[44]. Certainly, elevated levels of both surface and groundwater nitrate warrant further investigation in this subwatershed.

The Dutchess County Airport Creek transported relatively high suspended material, nitrate, and fecal coliform bacteria concentrations to the Wappinger Creek in 1999. The watershed planning team recommends that creation or


Dutchess County Airport
94
77
9
104
93
93
N
Scale 1:48,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
EMC
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July 2000
Dutchess County
Environmental Management Council

maintenance of storm water runoff devices, proper septic system siting and maintenance, and properly designed residential best management practices be implemented to help alleviate some of the water quality impacts in this subwatershed. Also, the destruction of the stream's vegetated buffer zone will increase sediment and nutrient loading to the stream, warm water temperatures, and threaten the ability of aquatic life to reproduce. Therefore, it should be a priority to protect or restore the natural vegetated buffer zone along the Dutchess County Airport Creek.

Wappingers Falls (Hunter Brook)

The Wappinger Falls subwatershed encompasses 6,519 acres in the southern portion of the Wappinger Creek watershed (Map 25). Contained within the Towns of Wappinger, Fishkill, and the Village of Wappingers Falls, this subwatershed comprises 5% of the entire Wappinger Creek watershed. Subwatershed land uses consist of 4% agriculture, 40% forested, 34% residential (third highest among all subwatersheds-see Table 8), 9.5% wetland and waterbodies, 7% commercial and shopping center, 1% transportation and communication, and 4% public land and outdoor recreation. The main stream in the Wappinger Falls subwatershed is Hunter Brook.

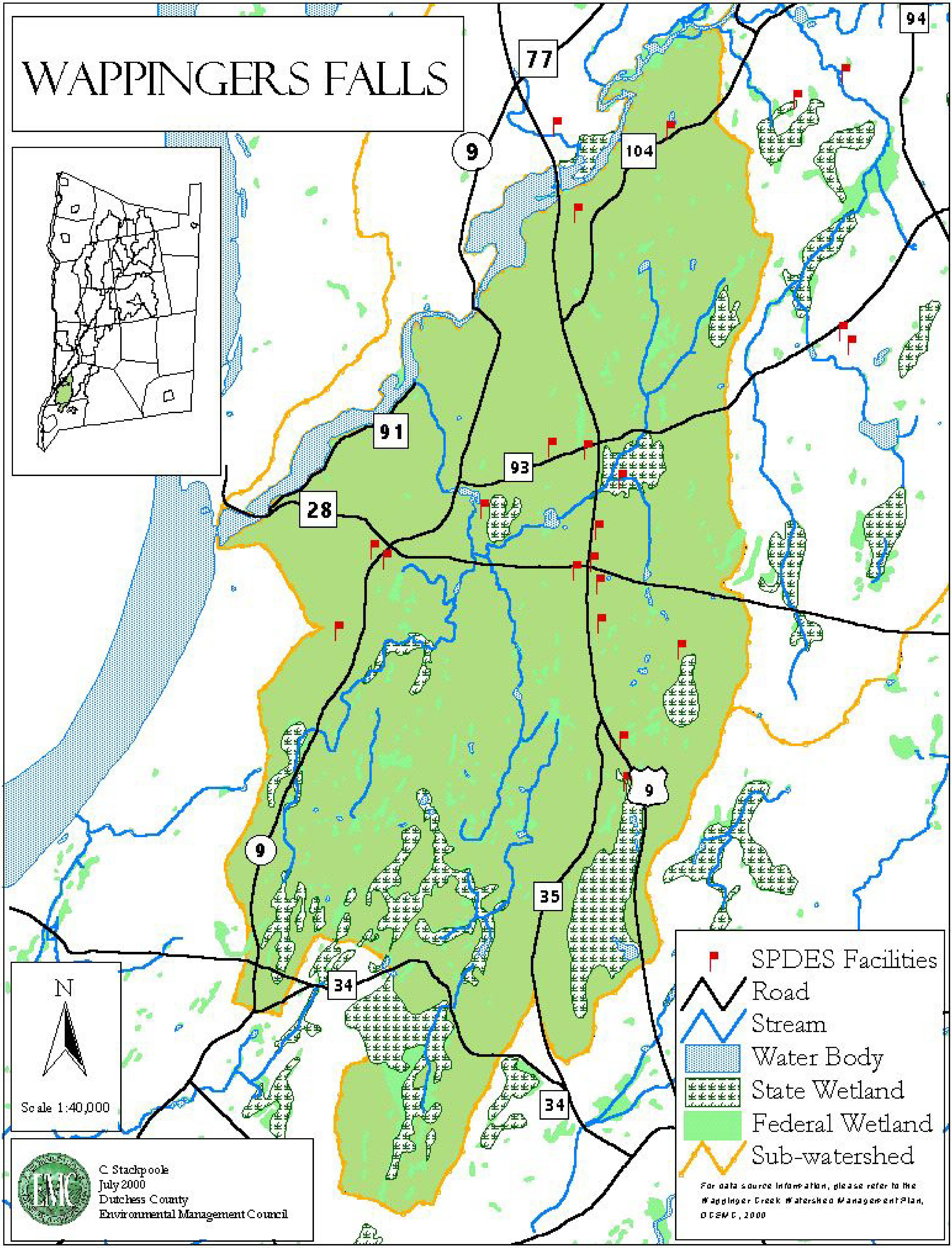
Well-drained soils can be found in 76% of the Wappingers Falls subwatershed. The dominant soil types are Dutchess-Cardigan complex at 50% and Bernardston silt loam at 11%. These soils tend to be well drained with a moderate permeability, making them poor for septic system siting. With these soil types water is generally available to plants throughout the growing season, and water usually doesn't inhibit root growth.

The NYSDEC has classified Hunter Brook primarily as a class D stream, with a small section classified as B waters (see Table 5). Class B waters may be used for swimming and fishing, while class D waters are usually suitable for fishing only.

Hunter Brook enters the tidal portion of the Wappinger Creek below Wappingers Falls. Therefore the EMC did not locate a stream sampling point on this tributary since the sampling program was designed to study the non-tidal 90% of the Wappinger Creek watershed upstream of Wappingers Falls. However, the fact that this tributary is given a D classification along with reports from Wappinger Falls Junior High School students of high nutrient levels and sewage odors and a large sediment plume at the mouth of the creek indicate poor water quality.

Weed growth and sedimentation in the Hudson River Estuary below Wappingers Falls

The watershed planning team recommends that creation or maintenance of storm water runoff devices, proper septic system siting and maintenance, properly designed residential best management practices, and the elimination of combined sewer overflows be implemented to help alleviate some of the potential water quality impacts in this subwatershed. Finally, the destruction of the stream's vegetated buffer zone increases sediment and nutrient loading to the stream, warms water temperatures, and threatens the ability of aquatic life to reproduce. Therefore, it should be a priority to protect or restore the natural vegetated buffer zone along Hunter Brook.



WAPPINGERS FALLS
94
77
9
104
91
93
28
9
9
35
34
34
N
Scale 1:40,000
SPDES Facilities
Road
Stream
Water Body
State Wetland
Federal Wetland
Sub-watershed
For data source information, please refer to the Wappinger Creek Watershed Management Plan, DCEMC, 2000
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V. Needed Pollutant Reductions

One of the primary objectives of this Management Plan is to identify the sources of nutrients and sediment to the watershed and ultimately to Wappingers Lake and to recommend management strategies to reverse the trend. Chapters III and IV have provided an analysis of the water quality monitoring study conducted in 1998 and 1999. Based on this analysis, the following subwatersheds should be targeted first for implementation of best management practices to reduce sediment and nutrient loading to the watershed.

The East Branch subwatershed had the second highest median sediment concentrations in 1999 and contributes the most flow of all the subwatersheds to the Wappinger Creek (Figure 4 and Figure 5). Therefore, the East Branch is contributing the most sediment load to watershed when compared to all other major tributaries. Other subwatersheds contributing significant amount of sediment to Wappingers Lake include Pleasant Valley East, Wappinger Creek Headwaters, Great Spring Creek, Dutchess County Airport, and Little Wappingers.

Nutrient (nitrate and phosphate) inputs vary among the subwatersheds, but it is clear that the Pleasant Valley East subwatershed is contributing the highest concentration of phosphate to the Wappinger Creek (Figure 3). Wappinger Creek Headwaters, Willow Brook and Great Spring Creek also showed concentrations of phosphate at or above levels that are likely to impact the ecological balance of the stream and lake. Although the Willow Brook Subwatershed contributes the smallest amount of flow to the Wappinger Creek of all the major tributaries, it contained the highest concentration of nitrates, almost 10 times the amount in the headwaters streams (Figure 2). Other contributors of high nitrate concentrations are Hunns Lake Creek, Upton Lake Creek, Great Spring Creek and Dutchess County Airport tributary.

As well as the impact of nutrient and sediment loading from subwatershed tributaries, inputs directly to the main stem of the Wappinger Creek are also occurring. To analyze these impacts further, the analysis of streambank erosion along the main stem of Wappinger Creek initiated in summer of 2000 should be continued in order to target areas for remediation. Also, a cumulative impact analysis of SPDES discharge sites along the Wappinger Creek and into Wappingers Lake should be done including total loading of nutrients. Based on the results of the cumulative impact study, the Watershed Planning Team should work with the NYSDEC to reduce these inputs.

Overall, the physical and chemical stream sampling programs conducted from 1997 to 2000 have shown that nitrate and phosphate levels in the subwatershed tributaries are fairly high throughout the Wappinger Creek watershed. Most likely, the nutrient concentrations can be attributed to the rapid groundwater transport of local septic system effluent, residential fertilizer applications, poorly planned storm water systems, and agricultural operations. Storm water inputs are a major contributor of nonpoint source pollution that needs to be addressed. Many stormwater collection systems are designed to funnel minimally treated or untreated water as quickly as possible to the local waterbody. Oil, petroleum products, nutrients, sediment, sodium chloride, litter, and bacteria are examples of some of the constituents of storm water runoff.

In the past, agricultural land uses were the major contributor of nutrients, sediment, and bacteria to the watershed. However, in Dutchess County agricultural land uses have declined approximately 21% from 1978 to 1997. It is now evident that residential land uses contribute equally to water quality degradation. With Dutchess County's population projected to grow 13% from 1980 to 2005, the burden will progressively be placed on residential land uses to improve and maintain good water quality.

Fecal coliform bacteria and phosphate levels tend to track the amount of suspended material in the water. Knowing this, it is recommended that people do not use the Wappinger Creek or its tributaries as swimming areas after large storms or whenever the creeks have a high turbidity. This also means that the streams may not be meeting classifications established by the New York State Department of Environmental Conservation.

The eutrophication of watershed lakes and ponds is a symptom of the elevated nutrients entering the watershed. An additional symptom of nitrate loading in the watershed is the increasing number of nitrate and bacteria contaminated drinking water wells[45] (Appendix 3).

One of the more troubling findings was the amount of fecal coliform bacteria present in subwatershed streams. These high levels of fecal coliform bacteria are probably discharging from poorly planned septic system drain fields, residential storm water runoff, and agricultural operations. The source varies by subwatershed, but the majority is probably a combination of the three.

Suspended material (sediment) transport in the subwatersheds varies greatly. This variability makes it difficult to draw conclusions based on subwatershed land use. However, it is evident that a number of the subwatershed streams consistently produce median suspended material levels that exceed the criteria developed by the EMC for healthy streams in this watershed (See Table 15 and descriptions for each subwatershed in the previous section).

The increased sedimentation may be due to the fact that during 1999 sampling, three of the twelve tributary sampling sites lost vegetated stream buffers. The destruction of the stream's vegetated buffer zone increases sediment and nutrient loading to the stream, warms water temperatures, and threatens the ability of aquatic life to reproduce. Eroding stream banks may also contribute to the phosphorous concentrations entering the watershed by releasing phosphorous from old agricultural fields that had since been converted to another land use.

The volunteer biological monitoring program has shown that, with the exception of the Mountain Road site, the Wappinger Creek is slightly impacted. This means that nutrient inputs and siltation are affecting the ability of macroinvertebrates that require high water quality to survive and reproduce in some areas. The Mountain Road site is moderately impacted by organic inputs from the large wetland, an intensively used barnyard, and stream channelization. Biological samples collected in the years to come will provide us with a clear picture of water quality trends over time.

VI. Management Strategies for Achieving Water Quality Goals & Objectives

The previous sections of this Watershed Management Plan have provided an overview of the watershed, data on water quality, and a summary of the land use and water quality impacts in each subwatershed. In this section, the watershed planning team offers suggestions for remediation and prevention of water quality impairments, including recommendations for wetland protection and enhancement.

Major Objectives

To ensure that the Wappinger Creek and its tributaries will meet their designated uses, there are four main objectives that need to be accomplished.

First, we must protect a vegetated buffer zone or "riparian buffer" around the streams, lakes and wetlands to minimize erosion from streambanks and lakeshores and to allow for filtration of pollutants before they reach waterbodies. A number of references are available at the offices of the EMC and the SWCD to assist local governments, land developers and planners in designing riparian buffer areas[46,47,48] *(Pictured above is an example of a stream in need of riparian buffer enhancement).*

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Second, nitrate, phosphate and bacteria inputs from sewage disposal systems need to be addressed. Short-term solutions include the remediation of small package sewage treatment plants that cannot handle infiltration during rainfall events, and consequently discharge raw sewage to our surface waters. For individual septic systems, siting should <u>not</u> include a drain field that discharges near a local waterbody, wetland, or neighbor's drinking well. As a long-term solution, the Watershed Planning Committee recommends the development of SPDES discharge criteria that are based on stream health and account for cumulative impacts.

The third objective is to restructure current residential development practices using "smart growth" land use planning. Smart growth is the application of "intelligent planning in communities throughout the country to maximize land use, existing infrastructure, and preservation of valuable vistas and environmentally sensitive areas".[49] An example of the need for smart growth is widespread nitrate contamination in public water supply wells in the watershed. This contamination can be attributed to high-density development utilizing individual septic systems, stormwater runoff, and agricultural practices. Without water and sewer infrastructure and careful examination of soil types, nitrate contamination will most likely increase with an increase in population and residential growth.

Finally, agricultural operations that are currently contributing to the nonpoint source pollution problem should be identified. In order to reduce the current nonpoint source pollution problems, large operations should be identified first for implementation of agricultural best management practices. Some of these operations are already involved in nonpoint source pollution reduction through the Agricultural Environmental Management Program (see Page 26). In addition, small farms and citizens with small animal populations should be given the tools to address water quality concerns.

Management strategies for achieving the four major objectives outlined above include wetland management and protection, Best Management Practices, land acquisition techniques, incentives, and education. Each of these categories of management strategies is outlined below, with examples provided. For a short description of each subcategory of Best Management Practices see Appendix 7.

Wetlands: Recommendations for Management and Protection

Wetlands are often referred to as "nature's kidneys", functioning as a filter for sediment and nutrients in the watershed. Wetlands also offer many other functions and values, including flood control, wildlife habitat, recreation and open space. Protection and management of wetlands in the watershed can provide a cost-effective means of maintaining water quality and will often prevent the need for the more costly structural management practices described later in this section.

According to an analysis of Real Property tax parcel codes, less than 2% of the wetlands in the watershed are publicly owned, leaving protection primarily in the hands of private citizens. To identify wetlands that were

Table 16. Wetlands Identified for Protection
(those designated by an * were identified by November, 1998 Watershed Conference Participants)

Wetland ID *(See footnotes * and † on next page)*	Class	Location	Acres	Watershed Locator
*MB-4	2	S. Stanford-Ludlow Rd	31	Tributary of Wappinger Creek
MB-18	1	Bontecou Lake - N. Washington, S. Stanford	557	Headwaters of Tamarack Creek
MB-48,	3	Institute of Ecosystem Studies -	30	East Branch Wappinger Creek
SP-68	2	E. Washington	105	
*PP-5	2	Pine Plains-Lake Rd	79	Wappinger Creek Headwaters
PP-8	1	N. Stanford, S. Pine Plains	1074	Wappinger Creek
*PP-12	2	Pine Plains-Willow Vale Rd	46	Tributary of Wappinger Creek
*PP-22	2	SW Pine Plains-Hicks Hill Rd	20	Tributary of Cold Spring Cr.
PP-56	1-ULI	Stanford	9	Grist Mill Subwatershed
PP-57	1-ULI	Stanford	8	Grist Mill and Cold Spring Creek Subwatersheds
*PV-2	2	SW Pleasant Valley NE Poughkeepsie	289	Great Spring Creek
PV-71	1-ULI	LaGrange	2	Overlook Road Subwatershed
RC-12	2	S. Milan along County Rte. 15	185	Little Wappinger Subwatershed
RC-32	2	N. Clinton – Silver Lake	82	Little Wappinger Subwatershed
RC-39	1	N. Clinton – Mud Pond	210	Little Wappinger Subwatershed
RC-52	2	N. Clinton – Long Pond	116	Little Wappinger Subwatershed
*SP-18	2	S. Clinton - Hollow Rd.	25	Tributary of Wappinger Creek
SP-56	2-ULI	Clinton	11	Upton Lake Subwatershed
*WF-1	3	N Wappinger - Nicholas Rd	38	Wappinger Creek
*WF-3	3	Wappinger-Rte. 9 & Meyers Cors.	56	Tributary of Wappinger Creek
WF-11	1	Greenfly Swamp	185	Headwaters of Hunter Creek
WF-13	2	Stonykill Environmental	48	Headwaters of Hunter Creek
WF-17	2	Education Center - N. Fishkill	42	Headwaters of Hunter Creek
WF-31 & Federal	1 L1UBHh	Wappinger and Poughkeepsie	30	Wappingers Lake
*Federal	R1UBV	W. Wappinger, S. Poughkeepsie	83	Wappinger Creek Estuary below Wappingers Falls
*Federal	PUBF PFO1E	Pine Plains, N. of Rte. 199	5	Wappinger Creek Headwaters
*Federal	PFO1A	N. Washington, W. of Rte. 82 On Wappinger Creek	9	Wappinger Creek
*Federal	PUBHx	Pleasant Valley, S. of Rte. 44	0.43	Tributary of Wappinger Creek

especially important for the functions and values mentioned above, the watershed planning team employed several methods. First, at the Watershed Conference in November 1998 participants were asked to pinpoint wetlands that they felt should be considered for management and protection on a large map of the watershed. Second, NYSDEC was contacted for information on wetlands of Unusual Local Importance in Dutchess County. Third, EMC staff reviewed data available at the EMC offices on Significant Natural Areas and Critical Environmental Areas. Fourth, field checking was carried out to document the characteristics of some of the smaller wetlands when limited published information was available.

Based on this research, the following 27 wetland areas in the watershed were identified as top priority for management and protection and are summarized in Table 16 (see Appendix 5 for a detailed list of wetlands in the watershed). These wetlands encompass 3,345 acres, or 40% of the wetlands in the watershed.

In this section, suggestions for management and protection of priority wetlands are made. Maps are included for those wetlands that include land in public or nonprofit ownership. For wetlands entirely in private ownership, maps are not provided to protect the landowner. In the future, the remaining 60% of wetlands in the watershed should also be examined for management strategies.

MB-4[*]: This 31-acre wetland on Ludlow Road in Stanfordville (Bangall) is located on a private estate and camel farm. The area is surrounded by woodlands and contains some standing water, important for wildlife habitat and flood control. The watershed planning team recommends that the Agricultural Environmental Management Program work with the landowners to implement best management practices to protect water quality and to develop a whole farm plan for the property.

MB-18: Bontecou Lake (also known as Tamarack Lake) in the towns of Stanford and Washington is one of the largest lakes in Dutchess County. Measuring approximately 113 acres, it is a privately owned, manmade lake with an additional 340 acres of adjacent wetlands that together support a wide variety of wildlife. This lake is well known for sheltering large numbers of geese, ducks and other waterfowl. Bontecou Lake was designated a Significant Natural Area by the EMC in the 1980's. The watershed planning team recommends that the Agricultural Environmental Management Program continue to work with the landowners around the lake to protect the water quality of this important resource. It is also recommended that Dutchess County agencies and land trusts work with the landowners to develop conservation easements or other long-term protection measures.

MB-48, SP-68: These wetlands are contained within the property owned by the Institute of Ecosystem Studies (IES), a 2000-acre internationally known research and educational facility in the Town of Washington. County residents have the opportunity to attend programs and courses offered by IES and to use the property for hiking and bird watching (a daily permit is required). IES was designated a Significant Natural Area by the EMC in the 1980's due to its size and diversity of vegetation and wildlife. The watershed planning team recommends that IES continue to provide stewardship for these wetlands through ownership and scientific research. At the same time, IES should also continue to provide public access in designated areas so Dutchess County residents will learn to appreciate the value of large tracts of land for biodiversity and open space.

PP-5: This wetland includes Twin Island Lake and the northern end of Stissing Lake in the Town of Pine Plains. These lakes and associated wetlands developed in glacial kettles at the headwaters of the Wappinger Creek and support diverse plant and animal communities. PP-5 is

[*] The NYSDEC assigns an identification number to all regulated wetlands. The capital letters refer to the USGS Quadrangle where the wetland is located; each wetland within that quadrangle is assigned a number. PP-56 refers to the Pine Plains Quadrangle, wetland # 56.

also important for flood control for the hamlet of Pine Plains. Twin Island Lake, Stissing Lake and Thompson Pond (part of PP-8 described below) were designated a Significant Natural Area by the EMC in the 1980's, and were identified by the 1998 Watershed Conference participants as important for protection.

PP-5 is almost entirely in private ownership, although the Town of Pine Plains owns a 10-acre piece of property at the southern end of Twin Island Lake. The Pine Plains Lions Club owns a very small lot on the northern end of Stissing Lake, used for an outdoor pavilion. The watershed planning team recommends that local government and county agencies work with the landowners around Twin Island Lake and the northern end of Stissing Lake to reduce nonpoint source pollution from homeowner practices and septic systems.

PP-8: This Class 1[*] wetland consists of over 1000 acres in the in the towns of Stanford and Pine Plains. As a headwaters wetland, PP-8 includes the southern end of Stissing Lake and the entire acreage of Thompson Pond. This wetland is important for flood control, maintaining the water quality of the Wappinger Creek and lessening the impact of the surrounding agricultural land[50].

In contrast to most of the wetlands in the watershed, about 75% of wetland PP-8 is owned by three nonprofit organizations: the Nature Conservancy, the Conservation and Preservation Association and the National Audubon Society-Buttercup Sanctuary (Map 26). The watershed planning team recommends that the Nature Conservancy pursue purchase of the additional land in the northern section of the wetland between Stissing Lake and Thompson Pond to buffer the acreage already owned by the Conservancy. It is also recommended that local government and county agencies work with the landowners around Stissing Lake to reduce nonpoint source pollution from homeowner practices and septic systems. Additionally, agricultural inputs to this wetland need to be addressed.

PP-12: This wetland, known as Keffer's swamp, is on Route 82A (now known as County Route 83) just past Willow Vale Road in the Town of Pine Plains. This wetland serves as the watershed divide between the Wappinger Creek headwaters and the Roeliff-Jansen Kill headwaters. Headwater wetlands are important for maintaining the quality and quantity of water in the drainage basin. The wetland may once have been owned or protected by a conservation organization, however more information is needed on this wetland's prior status.

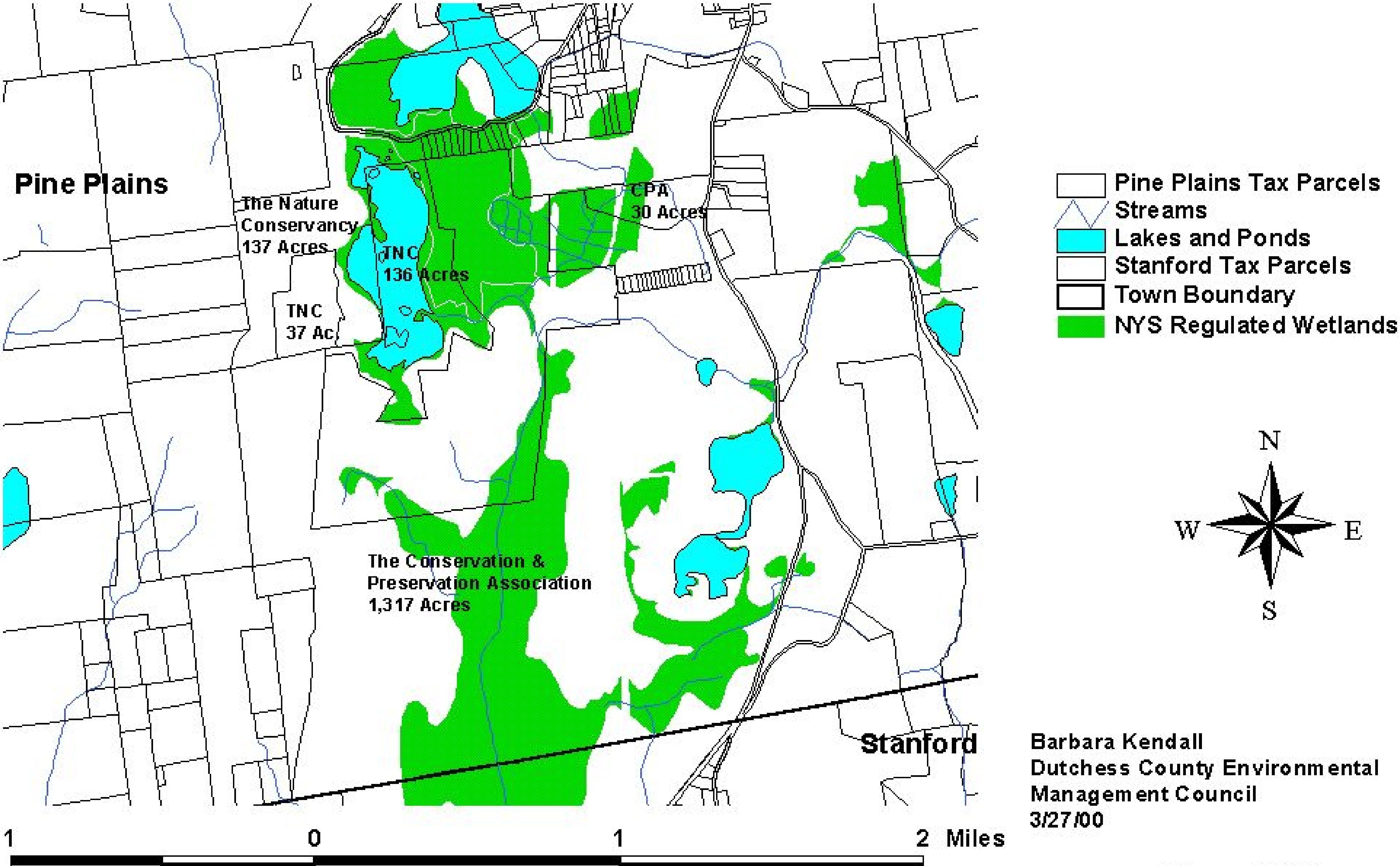
Privately owned, the area is surrounded by farmland, though most of the farmland is no longer in production. Since this wetland was identified at the 1998 Watershed Conference as an area important for protection, it is recommended that county and local agencies work with the landowners to provide conservation easements or other measure for protection of this headwater wetland.

PP-22: This 20-acre wetland is largely on private property in the southeastern portion of the Town of Pine Plains. PP-22 comprises part of the headwaters of the Cold Spring Creek, one of the few class B streams in the watershed.

Although PP-22 appears to be entirely on private property, it borders on the Stissing Mountain multi-use area owned by the NYSDEC. Since

[*] NYSDEC wetland classifications range from I (highest) to IV (lowest) based on various functional characteristics. ULI are wetlands less than 12.4 acres but are of Unusual Local Importance. Federal classifications are based on geological and hydrological characteristics. For a description of Federal and State classifications see Appendix 6.

Wetland PP-8 Upper Portion Non-Profit Ownership



Barbara Kendall
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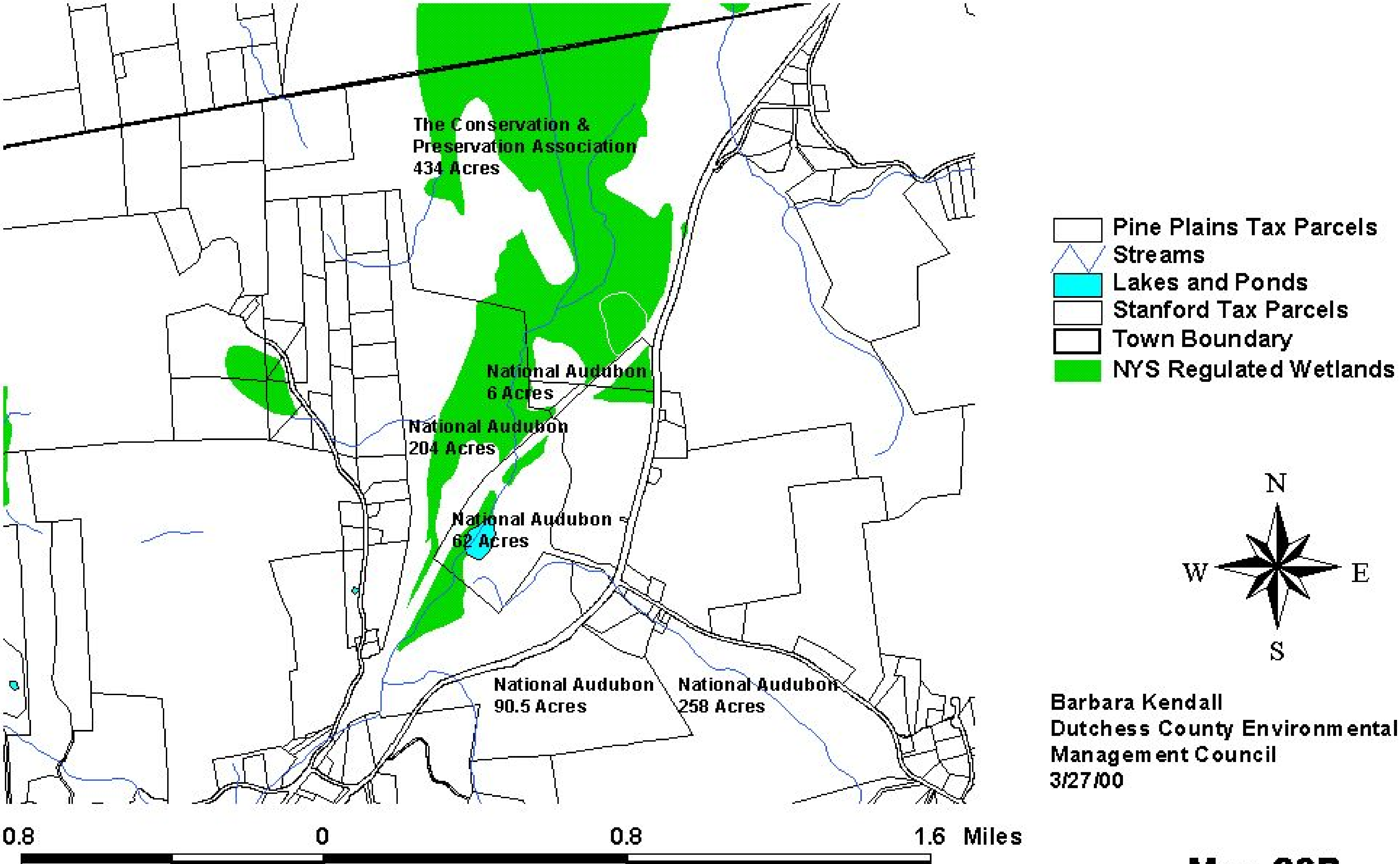
3/27/00

Map 26A

Wetland PP-8 Lower Portion
Non-Profit Ownership



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3/27/00

Map 26B

this wetland is important for protection of the water quality in Cold Spring Creek, the watershed planning team recommends that the NYSDEC explore expanding the multiple use area to include this wetland through purchase of land or conservation easements from the wetland landowners.

<u>PP-56 PP-57, PV-71, SP-56</u>: These four wetlands are less than 12.4 acres but are classified by the NYSDEC as regulated wetlands of Unusual Local Importance (ULI) due to the presence of endangered species. All four wetlands are entirely in private ownership. The watershed planning team recommends that state, county and local agencies work with the landowners to determine the status of the rare species and develop management plans for these important wetlands.

<u>PV–2:</u> This 289-acre wetland adjacent to the Great Spring Creek in Pleasant Valley is quiet, wooded, and had many birds. There is a housing development across the street from the wetland, but the area is generally undisturbed. This wetland is important for filtering of pollutants (the Great Spring Creek had the highest levels of fecal coliform bacteria in the watershed in 1999), wildlife habitat, open space and flood control for downstream residential and commercial areas.

PV-2 is entirely privately owned, with Central Hudson Gas & Electric in ownership of over 140 acres. Fecal Coliform bacteria samples collected by the DCEMC watershed staff in January 1998 showed high bacteria levels in PV-2 near Bower Road. This was troubling due to the extremely cold water temperatures that would normally promote the die off of fecal coliform bacteria. Further investigation may be warranted to discover the bacteria discharge location(s). The watershed planning team recommends that county agencies work with the Town of Pleasant Valley and landowners to protect the wetland through conservation easements and other measures.

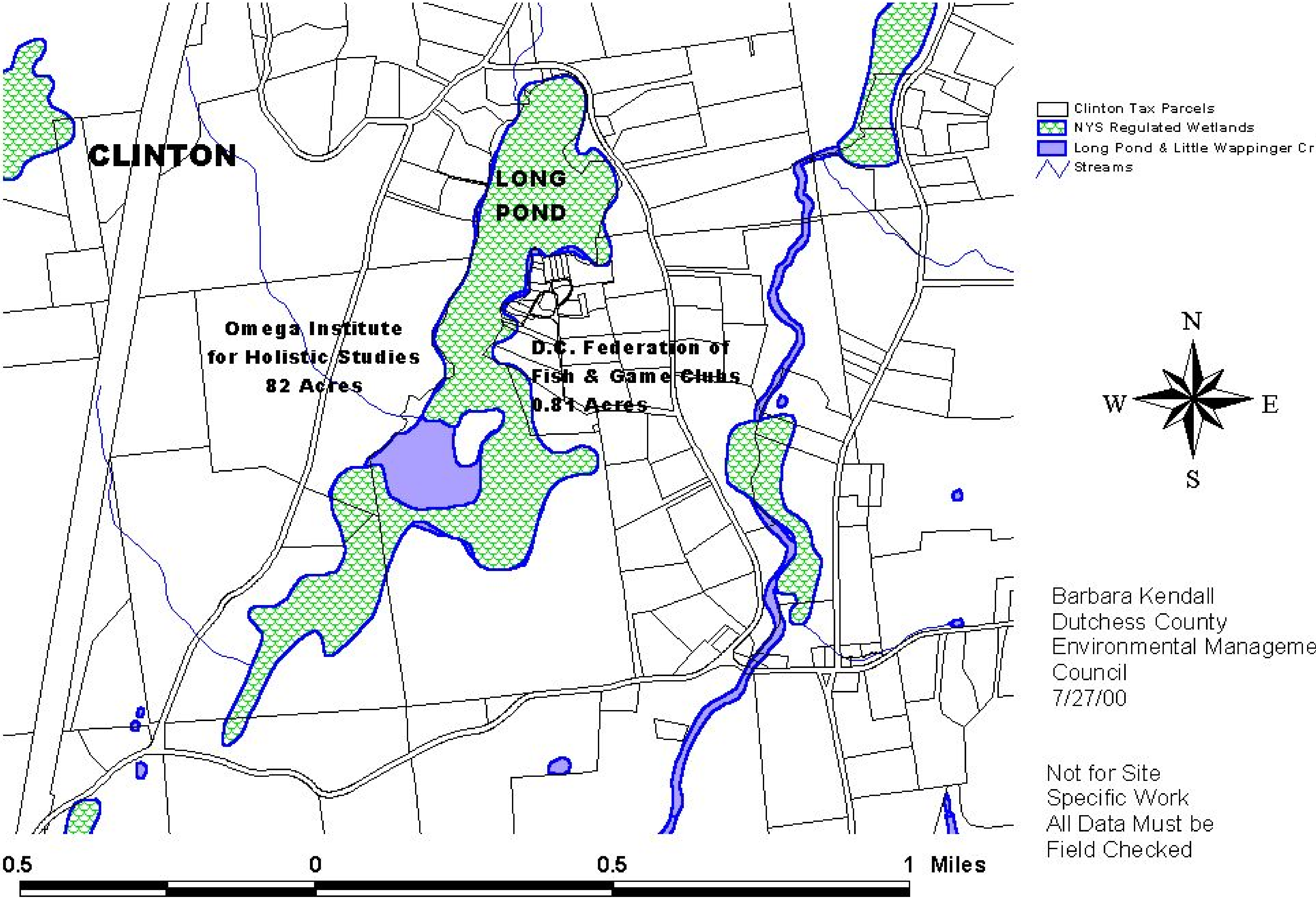
<u>RC-12, RC-32, RC-39 and RC-52</u>: Silver Lake, Long Pond and Mud Pond are an important chain of lakes in the town of Clinton. Silver Lake and Long Pond are the only Class AA lakes in the watershed, meaning that the water is of high quality, suitable for drinking. The lakes have been designated a Conservation Zone in the Town of Clinton Master Plan and a Significant Natural Area by the EMC not only for the quality of their water, but also for the hydrological effects they have on the watershed, especially the Little Wappinger Creek.

Perhaps the most significant components of the lakes, both ecologically and hydrologically, are the wetlands that border them. These three wetlands occupy nearly 250 acres of habitat adjacent to, and sometimes within the lakes, which is an important aquifer recharge area. Not only do these wetlands help maintain water quality, but they also provide critical habitat for rare and threatened species, provide flood control for residential developments near the lakes, and affect the hydrology and water quality of Little Wappinger Creek. Another significant aspect of the wetlands is that they overlie an important geological feature, a unique limestone deposit known as the Milan Window.

These four wetlands and the associated chain of lakes comprise almost 600 acres that is entirely in private ownership by over 50 landowners. There are only two nonprofit owners, the Omega Institute for Holistic Studies and the Dutchess County Federation of Fish and Game Clubs, both on Long Pond (Map 27). To protect these unique Class AA lakes and associated wetlands, state, county and local agencies must make a concerted effort to work with the landowners and lake associations to reduce nonpoint source pollution from homeowner practices and septic systems. Education should be emphasized to highlight the wetlands as important aspects of nonpoint source pollution control, wildlife habitat, and water retention.

<u>SP-18:</u> This 25-acre class 2 wetland is located north of Hollow Road in the Town of Clinton. Although the 1998 Watershed Conference participants identified this wetland as important for protection, very little information is available on the area, which is not visible from the road. More research is needed to determine the

Long Pond and NYS Regulated Wetland RC-52 Non-profit Ownership



Map 27

functions and values of wetland SP-18, which is entirely privately owned.

WF-1: This 38 acre wetland is located in the northwestern part of the Town of Wappinger off of St. Nicholas Road between Widmer Road and Route 104. The wetland surrounds Green's pond, and serves as flood protection, wildlife habitat and open space in an area of high-density residential development. Upon field survey the pond exhibited fish and bird activity. Identified at the 1998 Watershed Conference as important for protection, this wetland is privately owned, with a small portion owned by the Twin Lakes Sportsmen's Association. The watershed planning team recommends that county and local agencies work with the landowners to provide more long-term protection such as conservation easements.

WF-3: This wetland is located between Loose Road and Route 9 in Wappinger Falls and extends across County Route 93. 56 acres in size, the wetland is largely surrounded by housing developments and roadways. The portion of the wetland that borders the housing development provides a significant recreation area, as well as flood control and wildlife habitat.

This wetland was identified at the 1998 Watershed Conference as important for protection, and one landowner approached during the 2000 field survey noted that there was beaver activity in the wetland as well as wild turkey and numerous bird species. The landowner expressed her concern for the wetland and was excited about the possibility of protecting it. The watershed planning team recommends that county and local agencies work with the interested landowner and the other private owners of the wetland to inventory the plant and animal species and to investigate the possibility of protecting the wetland through conservation easements or other measures.

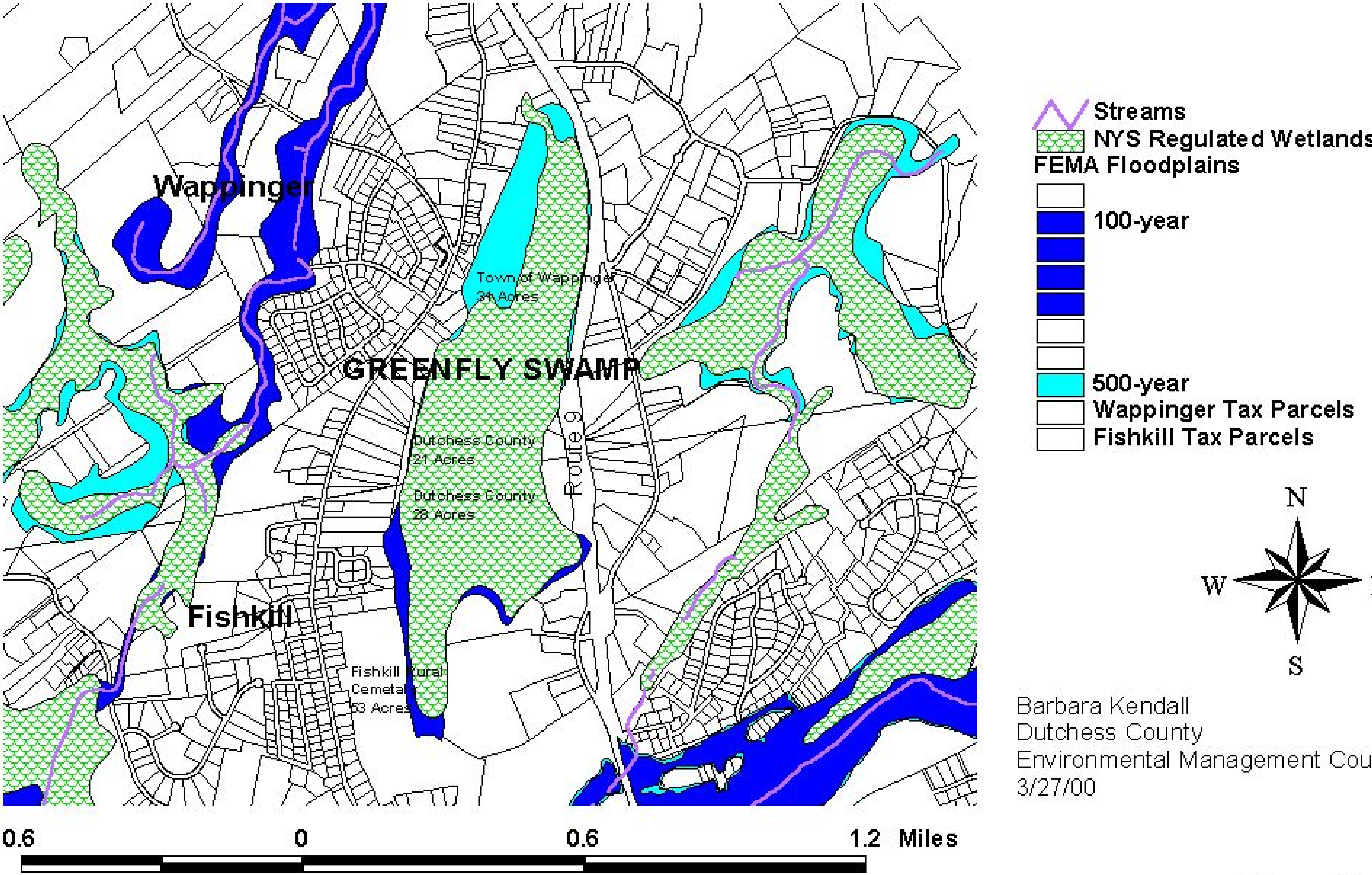
WF-11: Greenfly Swamp is a 185-acre Class I wetland in the towns of Wappinger and Fishkill that provides flood control, groundwater protection and wildlife habitat in a heavily populated area. Greenfly consists of marsh as well as bog areas, and provides habitat for diverse wildlife.[51] Students at Dutchess Community College conducted an environmental evaluation of this wetland in the spring of 1974. At the time, the Department of Solid Waste Management was considering siting a landfill in the general vicinity. On the basis of the students' research, not only was the area determined to be unfit for a landfill, but was also designated a Significant Natural Area by the EMC and recommended for protection from development based on its value for flood control and wildlife habitat.

The ownership of Greenfly Swamp consists of about 30% public (Dutchess County and the Town of Wappinger) and about 60% private landowners (Map 28). Since this wetland is extremely important for flood control and groundwater protection for the surrounding residential areas, the watershed planning team recommends that Dutchess County, the Town of Wappinger, and nonprofit organizations investigate increasing public ownership of this wetland and/or working with the private landowners to purchase conservation easements.

WF-13 and WF-17: Located in the towns of Wappinger and Fishkill, these wetlands (approximately 90 acres total) serve as the headwaters of Hunter Creek, an important tributary to the estuarine portion of the Wappinger Creek below Wappingers Falls. The wetlands are partially within Stony Kill Farm Environmental Education Center, a 467-acre facility in the Town of Fishkill owned by the NYSDEC (Map 29). Located in a rapidly developing area, Stony Kill offers opportunities for education and recreation to county residents. A rich variety of plants and animals live in the diverse habitats located on the property.

The New York State Education Department also owns portions of these wetlands on a 285-acre parcel in the Town of Wappinger, and there are also several private landowners. The watershed planning team recommends that NYSDEC and the NYS Education Department develop a joint plan to protect these wetlands including an inventory of plants and animals present.

Greenfly Swamp Public Ownership



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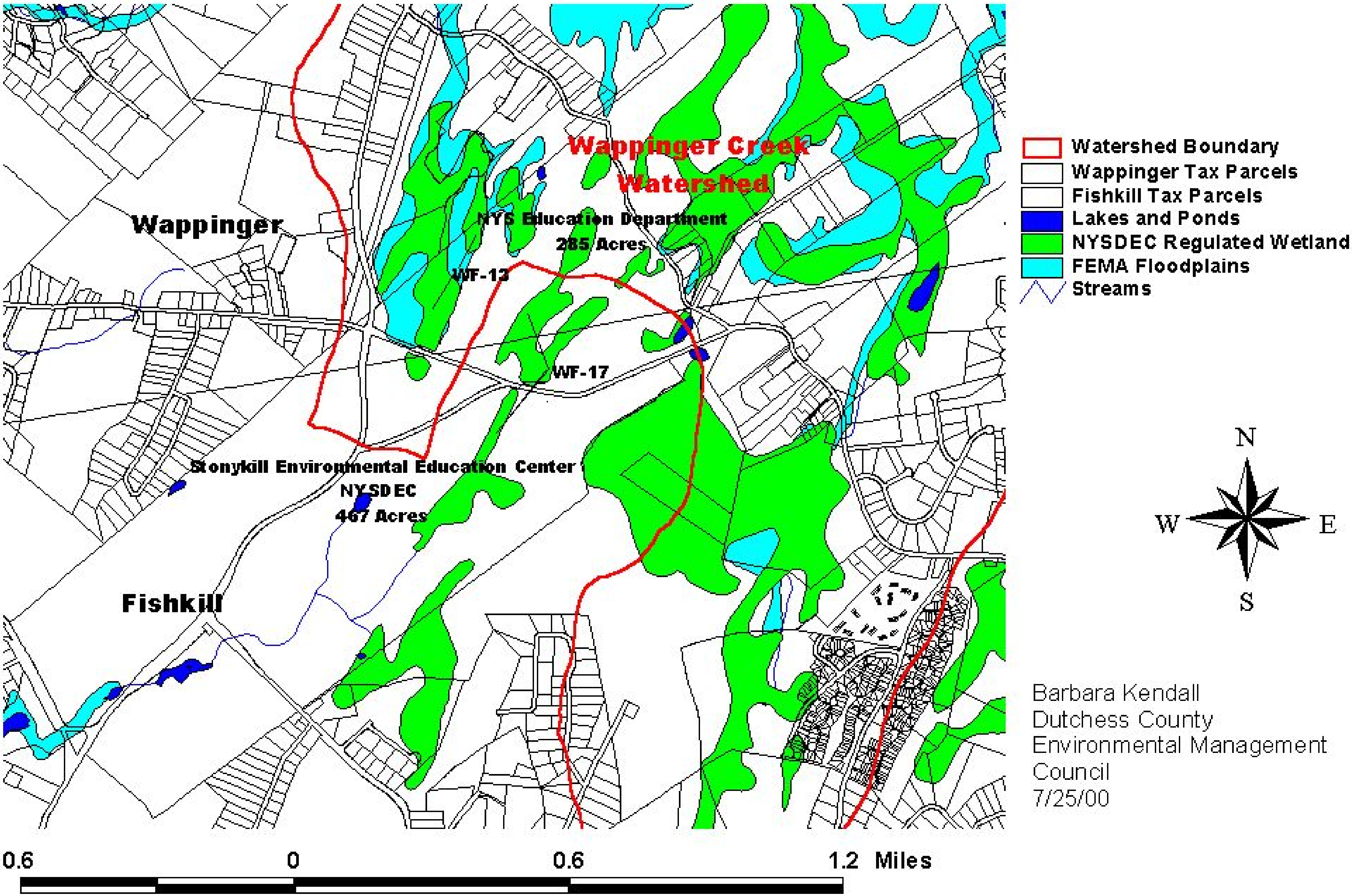
Dutchess County
Environmental Management Council
3/27/00

Map 28

Wetlands WF-13 and WF-17 Public Ownership



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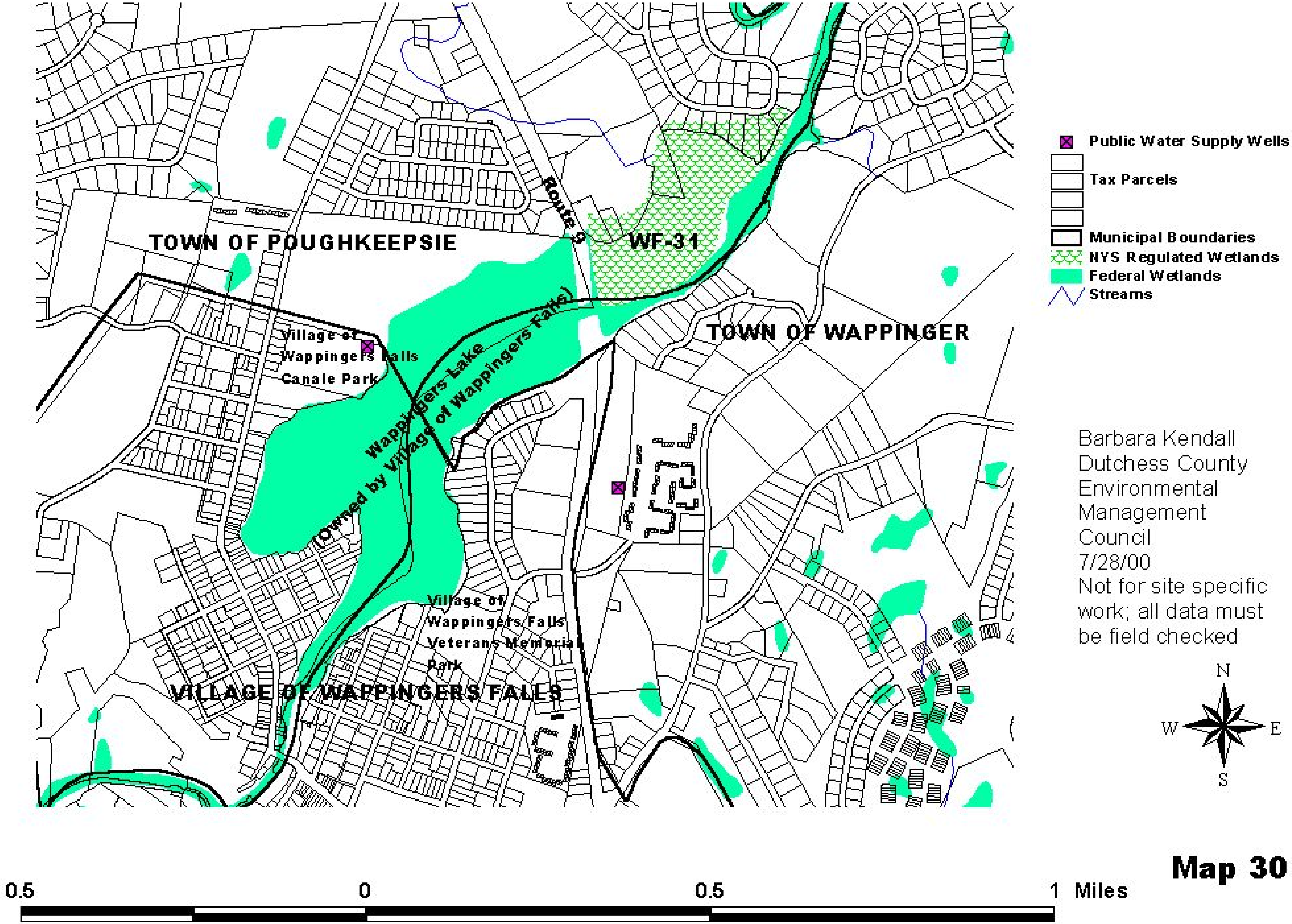
Map 29

Wappingers Lake Public Ownership and Associated Wetlands



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Environmental
Management
Council
7/28/00
Not for site specific
work; all data must
be field checked

Map 30

<u>WF-31 and Federal L1UBHh:</u> These wetlands comprise Wappingers Lake, a shallow, dam controlled lake owned by the Village of Wappingers Falls (Map 30). The lake is important for recreation, hydroelectricity, and maintenance of water quality for the Village of Wappingers Falls public water supply wells. The lake is part of the Lower Wappinger Significant Area designated by the EMC in the 1980's.

WF-31 is located north of NYS Route 9 in the Town of Poughkeepsie, and designated Class I by the NYSDEC due to its important function as flood control for the Village of Wappingers Falls, Town of Poughkeepsie and Town of Wappinger. However, the gradual siltation of the lake over the last 30 years has reduced the ability of the wetland and lake to absorb floodwaters, and nutrient inputs cause heavy weed and algae growth in the summer months, primarily consisting of water chestnut, a non-native invasive species. WF-31 is entirely privately owned.

Federal wetland L1UBHh is located south of NYS Route 9 and comprises the portion of Wappingers Lake owned by the Village of Wappingers Falls. Federal L1UBHh is hydrologically connected to WF-31 by several Route 9 bridges, and boat passage is possible. This section has been managed through weed harvesting and dredging periodically, and the Village purchased a weed harvester in 1999.

One of the primary objectives of this Management Plan is to identify the sources of nutrients and sediment to Wappingers Lake and its associated wetlands (the most degraded of all wetlands examined in this study) and to recommend management strategies to reverse the trend. Chapters III and IV have provided an analysis of the water quality monitoring study conducted in 1998 and 1999. Based on this analysis, the following subwatersheds should be targeted first for implementation of best management practices to reduce sediment and nutrient loading to the watershed.

The East Branch subwatershed had the second highest median sediment concentrations in 1999 and contributes the most flow of all the subwatersheds to the Wappinger Creek (Figure 4 and Figure 5). Therefore, the East Branch is contributing the most sediment load to Wappingers Lake when compared to all other major tributaries. Other subwatersheds contributing significant amount of sediment to Wappingers Lake include Pleasant Valley East, Wappinger Creek Headwaters, Great Spring Creek, Dutchess County Airport, and Little

Heavy summer weed growth on Wappingers Lake

Wappingers.

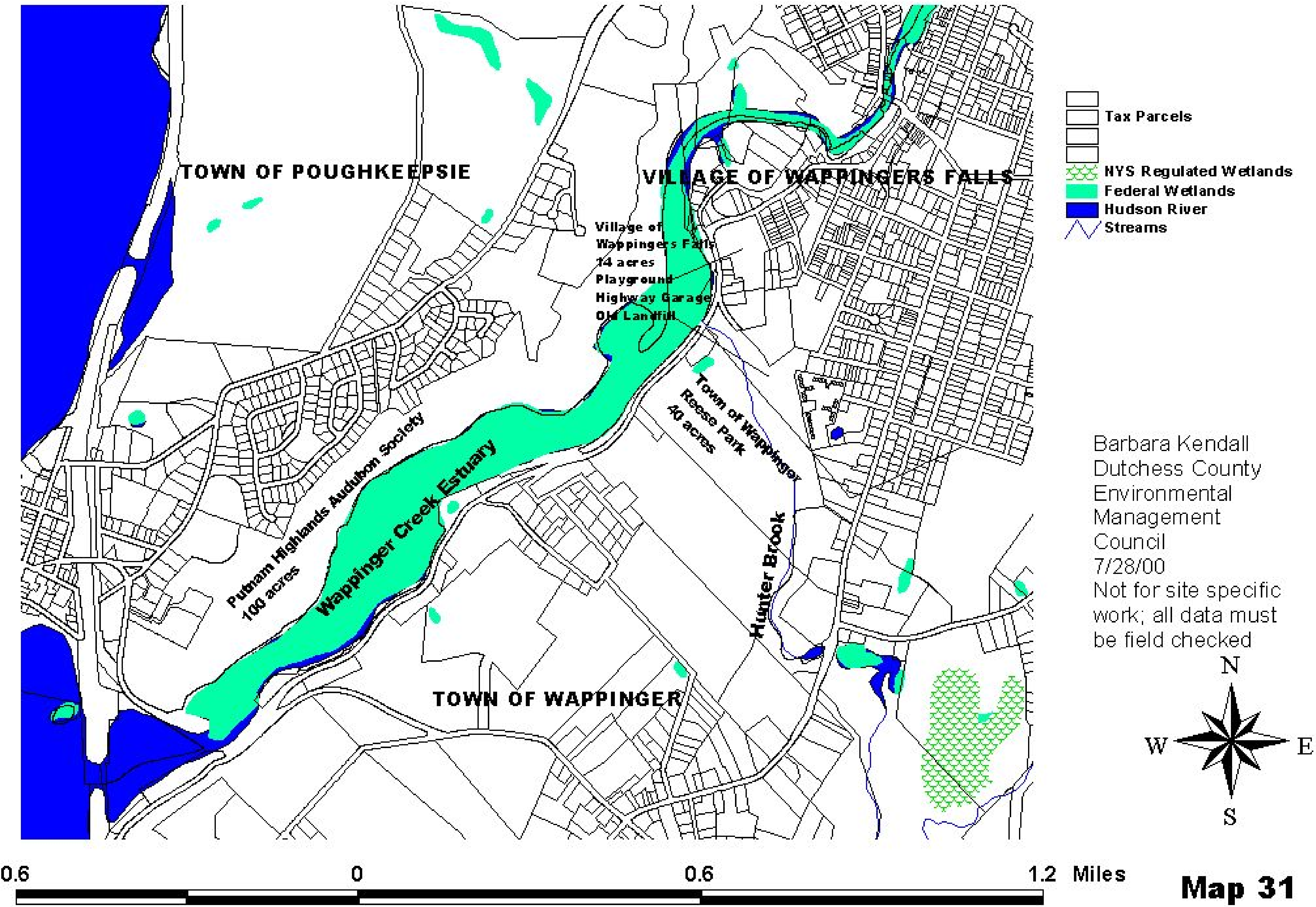
Nutrient (nitrate and phosphate) inputs vary among the subwatersheds, but it is clear that the Pleasant Valley East subwatershed is contributing the highest concentration of phosphate to the Wappinger Creek (Figure 3). Wappinger Creek Headwaters, Willow Brook and Great Spring Creek also showed concentrations of phosphate at or above levels that are likely to impact the ecological balance of the stream and lake. Although the Willow Brook Subwatershed contributes the smallest amount of flow to the Wappinger Creek of all the major tributaries, it contained the highest concentration of nitrates, almost 10 times the amount in the headwater streams (Figure 2). Other contributors of high nitrate concentrations are Hunns Lake Creek, Upton Lake Creek, Great Spring Creek and Dutchess County Airport tributary.

As well as the impact of nutrient and sediment loading from subwatershed tributaries, inputs directly to the main stem of the Wappinger Creek are also occurring. To analyze these impacts further, the analysis of streambank erosion along the main stem of Wappinger Creek initiated in summer of 2000 should be continued in order to target areas for remediation. Also, a cumulative impact analysis of SPDES discharge sites along the Wappinger Creek and into Wappingers Lake should be done including total loading of nutrients. Based on the results of the cumulative impact study, the Watershed Planning Team should work with the NYSDEC to reduce these inputs.

Federal R1UBV: This section of the Wappinger Creek is tidal for about 1.9 miles to the base of Wappingers Falls just east of the Market Street Industrial Park. The tidal conditions provide spawning ground for certain types of fish that require estuarine conditions to reproduce and is home to several rare species (see *Wildlife and Fisheries* on p. 23 and *Vegetation* on p.13). The estuary is part of the Lower Wappinger Significant Area designated by the EMC in the

Hudson River Estuary below Wappingers Falls

Wappingers Creek Estuary Public and Non-profit Ownership



Map 31

1980's and is a Hudson River Significant Tidal Habitat designated by the New York State Department of State in 1990[52]. This area is open to the public for recreation with a boat launch and Greenway Trail signs, however area residents have noted that erosion in the Wappingers Falls subwatershed has caused siltation in the estuary, which may threaten fish spawning and fish fry survival.

The Putnam-Highlands Audubon Society owns almost the entire western shore of the estuary (Map 31). Adjacent to the northeastern shore, the Town of Wappinger owns Reese Park and the Village of Wappingers Falls owns three parcels, a playground, highway garage and former landfill. Through a conversation with a representative of the Wappinger Creek Greenway Trail Committee, it was learned that the old landfill site is in need of cleanup and is a priority for action for the Committee. The watershed planning team recommends that the Putnam Highlands Audubon Society, the Town of Wappinger, and the Village of Wappingers Falls form a partnership to address the siltation, old landfill cleanup, public access and other priorities identified by the Wappinger Creek Greenway Trail Committee to protect this unique and important area.

Federal PUBF and PFO1E: This wetland is located just past the intersection of Rte. 199 and Bowman road in Pine Plains. The wetland consists of two areas, one just to the side of the road down a small ravine and the other a little further down Bowman Road in front of an old farm. This wetland complex is entirely owned by one landowner, and is partially in the floodplain of the Wappinger Creek headwaters. More information is needed on this wetland, which is important for flood control for the hamlet of Pine Plains and water quality protection for the headwaters of the Wappinger Creek.

Federal PFO1A: This 9-acre area west of Route 82 in Salt Point is located entirely in the floodplain of the Wappinger Creek. The area was difficult to observe during the field survey since it is down a steep slope on private property owned by two major landowners. Although this wetland was identified by 1998 Watershed Conference participants as important for protection, more research is needed to provide recommendations for management of the area.

Federal PUBHx: This wetland is off of Route 44 in Pleasant Valley. It is documented as less than an acre, but a recent field survey notes that it is larger, probably several acres, and important for flood control in this residential area near a major highway. Privately owned, the wetland contains two spring-fed manmade ponds, which are used for swimming and bird watching by the landowner. There is also an excavated drainage channel for runoff from a neighboring pond. The watershed planning team recommends that county and local agencies continue to work with the landowner to suggest long-term protection measures for this wetland such as conservation easements.

Federally regulated floodplain wetland PUBHx in the Town of Pleasant Valley

Best Management Practices

Water quality goals can be achieved by implementing Best Management Practices, also known as BMPs. BMPs are activities or structures that prevent or reduce the availability, release or transport of substances that adversely affect surface and ground waters (such as sediment and nutrients). A management practice is a means of achieving desired results, whether it is implemented by a private, commercial or governmental entity, and whether through voluntary action, financial incentives, or regulatory requirements.

How to Use This Section

This section describes management practices that can be implemented for various water quality impairments. To use this section, first identify the subwatershed you are interested in on Map 1. Second, turn to Tables 14 and 15 to identify the impairments present in a particular subwatershed. Third, turn to the subwatershed description in Section IV to find the category of management practice that is recommended to maintain or improve water quality. Finally, turn to the management practice category you have selected in this chapter. For more in-depth descriptions see Appendix 7.

For example, the Dutchess County Airport subwatershed description notes that creation or maintenance of storm water runoff devices, proper septic system siting and maintenance, properly designed residential best management practices and riparian buffer enhancement would help alleviate some of the water quality impacts in this subwatershed. Therefore, turn to the pages in this section on *Urban/Stormwater Management Practices, On-Site Wastewater Treatment Systems Management Practices,* and *Roadway and Right-of-Way Management Practices* for suggested activities to improve water quality. Site-specific field study will need to be done to determine the specific management practice that is best for a particular area.

To provide background on the management practices, each type of practice is discussed below in summary form. Short descriptions of each practice can be found in Appendix 7, and detailed descriptions can be found in one of the seven *Management Practices Catalogues for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State* available from the NYS Department of Environmental Conservation (see Appendix 4 for address). Please note that the title of each of the management practice categories in this section is the same as the title of the management practice catalog available from the NYSDEC. Additional information may be obtained in *New York Guidelines for Urban Erosion and Sediment Control*[53], available from the Empire State Chapter, Soil & Water Conservation Society and the D.C. Soil & Water Conservation District.

Agricultural Management Practices

Agricultural Management Practices are designed to prevent or reduce nonpoint source water pollution from barnyards, cropland and pasture. These practices may involve engineering and construction measures, or changes in farm practices and methods. The Agricultural Environmental Management Program, (see Section II, page 26) through the County Project Team, can provide technical assistance and coordinate local, state, and federal cost-sharing and incentive programs to carrying out these measures.

The following is a list of agricultural management practices. For a short description of these practices see Appendix 7. For a detailed description of each practice see the "*Agricultural Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State*" available from the NYSDEC[54] (see Appendix 4 for address).

- Access Road Improvement
- Barnyard Runoff Management System
- Conservation Tillage
- Constructed Wetlands
- Contour Farming
- Cover and Green Manure Crop
- Critical Area Protection
- Permanent Vegetative Cover

- Structural Slope Protection
- Streambank & Shoreline Protection
- Mulching
- Temporary Vegetative Cover
- Crop Rotation
- Diversion
- Fencing
- Filter Strip
- Grassed Waterway
- Integrated Pest Management
- Irrigation Water Management
- Nutrient Management
- Nutrient/Sediment Control
- Pasture Management: Short-duration Grazing Systems
- Riparian Forest Buffer
- Stripcropping
- Terraces

Construction and Resource Extraction Management Practices

Soil erosion from construction in areas where exposed soil is subject to erosion from heavy rainfall events is one of the major causes of sedimentation in the Wappinger Creek Watershed, especially in the southern half of the drainage basin (Table 15). Sedimentation from construction is also one of the causes of impairment of Wappingers Lake, as noted in the Priority Water Body data sheet (Appendix 2). Even though earth disturbances may take place for a relatively short period of time, the movement of sediment and other pollutants is often severe[55]. In addition, uncontrolled construction site sediment loads have been reported to be on the order of 35 to 45 tons per acre per year[56]. Loadings from undisturbed woodlands are typically less than 1 ton per acre per year[57].

Best Management Practices can be used to prevent erosion from construction sites. The following is a list of best management practices developed by the Construction Management Practices Sub-Committee of the New York State Nonpoint Source Management Practices Task Force. For a short description of each practice see Appendix 7. Detailed descriptions of these practices can be found in the *Construction Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State* available from the NYS Department of Environmental Conservation[58] (see Appendix 4 for address).

- Administrative Control Mechanisms
- Check Dam
- Construction Road Stabilization
- Construction Waste Management .
- Critical Area Protection
- Diversions
- Dust Control
- Filter Strip
- Grade Stabilization Structure
- Grassed Waterway
- Hazardous Material Management
- Level Spreader
- Lined Waterway or Outlet
- Paved Flume
- Pipe Slope Drain
- Planned Land Grading
- Riparian Forest Buffer
- Silt Fence
- Stabilized Construction Entrance
- Staged Land Clearing and Grading
- Storm Drain Inlet Protection
- Straw Bale
- Sub-surface Drain
- Sump Pit
- Temporary Dike/Swale
- Temporary Sediment Basin.
- Temporary Sediment Trap
- Temporary Storm Drain Diversion
- Temporary Watercourse Crossing
- Topsoiling
- Turbidity Curtain
- Waterbar

Hydrologic and Habitat Modification Management Practices

Hydrologic modification includes stream channelization, dredging, and flow regulation or modification through the use of dams and other structures. Habitat modification occurs when riparian (riverside) vegetation is removed, streambanks are modified and destabilized, and surface water is impounded behind a dam or other structure altering the type of habitat available to plants and animals. Somewhere between 70 and 90 percent of natural riparian ecosystems in the United States have been lost due to human activity[59]. These activities can have both short- and long-term effects on water quality and water quantity in the watershed.

The following practices can be used to lessen the impact of these activities on water resources. For a short description of each practice see Appendix 7. Detailed descriptions can be found in the "*Hydrologic and Habitat Modification Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State*" available from the NYSDEC[60] (see Appendix 4 for address).

- Modifying, Operating and Maintaining:
- Flood Control Structures
- Reservoirs
- Proper Dam Breaching
- Streambank and Shoreline Protection
- Water Quality and Habitat Protection:
- Constructed Wetlands
- Improving Instream and Riparian Habitat
- Restoring Freshwater Wetlands
- Restoring Tidal Wetlands
- Riparian Forest Buffer
- Stream Corridor Protection Program (Greenbelting)

Leaks, Spills and Accidents Management Practices

The storage and transport of petroleum products is regulated at the federal and state level by the EPA and the NYSDEC. The following is a list of practices that are required by these agencies, with references for more information contained in the "*Leaks, Spills and Accidents Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State*" available from the NYSDEC[61] (see Appendix 4 for address).

- Containing Leaks and Spills
- Controlling Initial Spills (First Response)
- Detecting Leaks and Spills
- Facility Inspection, Facility Maintenance and Personnel Training Programs
- Good Housekeeping Practices
- Materials Compatibility Analysis
- Proper Design of Tanks, Piping Systems and Containment Structures
- Proper Materials Handling and Transfer Operations
- Recordkeeping
- Risk Identification and Assessment
- Security Measures
- Spill Reporting Procedures
- Temporary and Permanent Closure of Storage Facilities
- Testing and Inspecting Underground Storage Tank Systems
- Upgrading Storage Systems

On-site Wastewater Treatment Systems (septic systems) Management Practices

Four waterbodies in the watershed (Silver Lake, Long Pond, Hunns Lake and Upton Lake) exhibit elevated levels of nutrients (nitrates and phosphates), with septic systems believed to be the primary source as noted in the Priority Water Body data sheets[62] (Appendix 2). Impairment of waterways occurs when septic systems fail, when systems are densely located in a residential or commercial area[63], or when soil types do not allow for filtration of nutrients before they reach groundwater or waterways.

The following are techniques that can be used by contractors and local government to reduce the impact of septic systems on water quality. For a short description of each practice see Appendix 7. For a detailed description of these practices see "*On-site Wastewater Treatment Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State*" available from the NYS Department of Environmental Conservation[64] (see Appendix 4 for address). Please note that all wastewater treatment systems must be approved by the Dutchess County Department of Health.

- Administration, Operation and Maintenance

- Inspection and Pumping
- Administrative Control Measures
- Septage Disposal Management
- Aerobic Systems and Standard Absorption Fields - Proper Installation
- Alternative Systems
- Raised Systems
- Elevated Sand Mounds
- Intermittent Sand Filters
- Conservation Measures
- High Efficiency Plumbing Fixtures
- Graywater Separation
- Engineered Systems for Nitrate Removal
- Anaerobic Upflow Filters (AUF)
- RUCK System
- Recirculating Sand Filters
- Non-Waterborne Systems
- Constructed Wetlands
- Examination of Site and Soils:
- Soil and Site Analysis
- Percolation Tests
- Deep Test Holes
- Innovative or Other Systems
- Holding Tanks for All Wastewater
- Rotating Biological Contactors
- Trickling Filter-type Systems
- Other Conventional Systems:
- Gravelless Absorption Systems
- Deep Absorption Trenches
- Shallow Absorption Trenches
- Cut and Fill Systems
- Absorption Bed Systems
- Seepage Pits
- Public Education
- Advocating Proper System Design and Construction
- Proper Use and Disposal of Household Hazardous Substances
- Septic Tanks and Standard Absorption Fields (Trenches) - Proper Installation

Roadway and Right-of-way Maintenance Management Practices

State, county and local highway departments have the responsibility of maintaining our roadways in a safe condition. This entails the use of deicing materials (salt and sand), herbicides and asphalt preparations. However, the use and storage of these materials can also cause water quality impairment when activities are located near streams, lakes or storm drains which are often direct connections to local waterways.

The following are management practices that can be used to lessen the impacts of road maintenance activities on water quality. For a short description of each practice see Appendix 7. For a detailed description of these practices see the "*Roadway and Right-of-Way Maintenance Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State*" available from the NYSDEC[65] (see Appendix 4 for address).

- Abrasive and Deicing Material Application and Cleanup
- Catch Basin Cleaning
- Control of Bridge Paint Residuals
- Deicing Material Mixing and Handling
- Dust Control
- Filter Strip
- Herbicide Management-Selective Herbicide Application in Sensitive Areas
- Maintenance of Vegetative Cover
- Proper Mechanical Control of Vegetation
- Proper Road Ditch Maintenance
- Proper Species Selection for Vegetative Cover
- Restoration of Disturbed Areas Within the Right of Way
- Salt Storage System:
- Drainage Engineering
- Elevation of Foundation/Floor
- Shelter/Cover
- Site Location Selection to Protect Water Resources
- Street Sweeping/Road Cleanup

Silviculture Management Practices

Silviculture management practices are simple, low-cost practices and techniques that can be incorporated in the timber harvest to protect water quality, maintain the productivity of the forest, improve public confidence in timber harvesters, and maintain public support for forest management and timber harvesting. Erosion and sedimentation are the primary potential nonpoint source pollution problems associated with forest management activities, especially at stream crossings for forest roads and skid trails[66]. Other associated problems include the removal of overstory vegetation shade that can increase water temperatures, and harvesting operations can greatly increase the amount of organic material (leaves, sticks, etc.) in the waterbody, which can deplete oxygen and alter stream habitats[67].

The following is a list of silvicultural management practices. For a short description of each practice see Appendix 7. For detailed descriptions of these practices see the "*Silviculture Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State"* available from the NYSDEC[68] (see Appendix 4 for address). Also see the excellent field guide titled, "*New York State Forestry - Best Management Practices for Water Quality: BMP Field Guide*", recently published by Empire State Forest Products, NYSDEC, and the Watershed Agricultural Council[69].

- Hazardous Material Management.
- Planned Access Routes
- Planned Harvest Operations
- Planned Watercourse Crossings
- Riparian Buffer Protection
- Road Water Management
- Sediment Barriers
- Vegetation Establishment

Urban/Stormwater Runoff Management Practices

Stormwater causes a significant proportion of water quality impairments in urban areas. Stormwater is usually conveyed to streams through storm sewers, roadside ditches, grassed swales, and ponds. Typically, storms sewers transport runoff rapidly with no pretreatment or filtering before the runoff enters local streams[70].

Pollutants found in urban runoff include heavy metals, toxic organic chemicals, sediment, nutrients, bacteria and protozoa. Also, urban runoff may cause flash flooding because pavement and rooftops prevent rainwater and snowmelt from soaking into the ground.

The following is a list of structures and practices that can be used to filter pollutants or reduce the impact of stormwater on water bodies. For a short description of each practice see Appendix 7. For detailed descriptions of these practices see the "*Urban/Stormwater Runoff Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State"* available from the NYSDEC[71] (see Appendix 4 for address).

- Catch Basins
- Collection & Treatment of Stormwater
- Concrete Grid & Modular Pavement
- Constructed Wetlands
- Critical Area Protection
- Diversions
- Dry Detention Basins
- Extended Detention Basin
- Filter Strip
- Fluidic Flow Regulators
- Grassed Swales
- Grassed Waterways
- Implementation of Land Use Planning For Watershed Protection
- Infiltration Basins, Pits and Trenches
- Integrated Pest Management
- Irrigation Water Management
- Nutrient Management
- Composting Yard and Home Wastes
- Fertilizer Management
- Soil Testing
- Pathogen/Nutrient Management Control:
- Nuisance Bird and Waterfowl Waste Management and Control;
- Pet Waste Management and Control;
- Peat/Sand Filter System.
- Pesticide Management
- Porous Pavement
- Proper Use and Disposal of Household Hazardous Substances

- Public Education.
- Reduction of Traffic-generated Pollutants
- Retention Pond (Wet Pond)
- Riparian Forest Buffer
- Roof Runoff System
- Stormwater Conveyance System Storage
- Stream Corridor Protection Program
- Street and Pavement Sweeping
- Urban Forestry (Trees and Shrubs)
- Water Quality Inlet (Oil/Grit Separators)

Incentives

Tax incentives, cost sharing programs, and award programs can be effective in protecting critical wetlands, watercourses and habitat areas. Tax reductions can be made at the local and county level for deed restrictions, covenants and conservation easements on properties identified for protection. There is also an opportunity for a reduction in income taxes through several donation and gift provisions in the Internal Revenue Code, which can provide attractive incentives for wetland and floodplain protection to landowners[72].

Open space assessment programs can be effective where the locality has adopted an open space plan. Within the guidelines of the open space plan or local master plan, assessments supporting local services such as water, sewer, and flood control can be reduced on property that will not be developed in the future.

The following are examples of cost sharing and award programs used both locally and on a national level:

Wetland Reserve Program (WRP):
WRP is an U.S. Department of Agriculture (USDA) program to help farmers and other landowners take agricultural lands out of production and restore them as wetlands. Technical Assistance is provided by USDA's Natural Resource Conservation Service (NRCS). In exchange for the landowner's agreement to restore and protect the wetland, payments are made for establishing wetland easements on eligible property. For permanent easements, 100% of all eligible costs and the appraised agricultural value of the land are paid. For 30-year easements, 100% of all eligible costs and 75% of the appraised value is paid. Wetlands eligible for the program include prior converted cropland, farmed wetlands, farmed wetland pasture, stream corridors, or land substantially altered by flooding. The applicant must own the land for at least 12 months before the end of the sign-up period, and must have a clear title.

Wetland restoration agreements are also available, either in conjunction with an easement or as a stand-alone contract, where the landowner agrees to maintain certain conservation practices for 10 years. Under the restoration program the landowner or another source of funding pays 25% of the cost and USDA-NRCS pays 75%.

Conservation Reserve Program (CRP):
CRP encourages farmers to voluntarily plant permanent areas of grass and trees on land that needs protection from erosion, to act as windbreaks, or in places where vegetation can improve water quality or provide food and habitat for wildlife. Farmers must enter into 10 to 15 year contracts with the United States Department of Agriculture's Commodity Credit Corporation (CCC). In return, they receive annual rental payments, incentive payments for certain activities and cost-share assistance to establish protective vegetation. Eligible land includes cropland that was planted to an agricultural commodity in 2 of the 5 most recent crop years, and marginal pastureland that is suitable for use as a riparian buffer to be planted to trees. Landowners who have owned the land for at least one year or operators who have leased the acreage for at least one year are eligible.

Environmental Quality Incentive Program (EQIP):
The objective of this program is to control soil erosion and to protect water quality through cooperation between federal, state and local agencies. EQIP is limited to areas targeted by the local working group, which consists of a

representative from the SWCD, USDA-NRCS, USDA-Farm Service Agency, NYSDEC, the Dutchess County Farm Bureau, and local farmers. The program utilizes 5 to 10 year contracts that provide cost sharing and technical assistance. EQIP pays up to 75% of the cost to establish conservation practices such as manure management, nutrient management and erosion control systems. Cost sharing and incentive payments are limited to $10,000 per person per year.

Septic System Maintenance

This watershed management plan has emphasized that septic systems in proximity to waterways, especially on sandy soils, can be one of the causes of elevated nutrient and bacteria levels in streams and lakes, and nitrate contamination in groundwater wells. Simple maintenance by pumping the septic tank once every three to five years can prevent failure and resulting pollutant loading. However, many homeowners prioritize other maintenance and utility costs first or do not realize that their septic system must be maintained until it is too late, and find that the cost of repair is prohibitive. To solve this problem, water quality agencies can work with local septic haulers to provide discount coupons or volume discount programs around lakes. Also, grant programs may be available to provide septic system repair costs near critical waterways and habitats.

Green Community Award

"Sustainable Community" or "Green Community" Awards programs have become popular in the last several years to highlight collaborative efforts at making communities more sustainable. Nationally, awards have been given for cities and counties working together on the following topic areas[*]: Regional Growth Management and Joint Land Use Planning, Reusing Existing Public and Private Infrastructure and Brownfields Redevelopment, Workforce Development, Better Environmental Services Management, and Reducing Violence and Creating Healthy Communities.

An example of the Joint Land Use Planning category is the award given for the Lancaster County Growth Management Strategy. Lancaster County, Pennsylvania, and its 60 independent municipalities have come together to address development in a unified and coordinated manner. Hundreds of public meetings, countywide surveys, and citizen opinion polls have resulted in the adoption of The Lancaster County Growth Management Strategy, which is an action agenda to manage growth; contain sprawl; preserve greenspace and agricultural land; protect water quality; and clean up brownfields.

Another example of innovate planning strategies is the award given for the Treasure Valley Partnership (TVP) in Idaho. The TVP was formed by Ada and Canyon Counties along with the Cities of Boise, Meridian, Garden, Nampa, Caldwell, Eagle and Kuna. This proactive coalition allows neighboring area leaders to unite to discuss regional growth issues. The TVP's efforts are strengthening cooperative activities in areas such as transportation, parks, water supply and quality, air quality, public safety, emergency management and disaster preparedness.

An example of the Better Environmental Services category is the award given for innovative wastewater treatment technology in California. The Cities of San Bernardino and Colton, California have partnered with a regional water agency to build an innovative tertiary wastewater treatment plant. The process the plant uses, called rapid infiltration/extraction, has saved local taxpayers millions of dollars in construction and operating costs, and produces extraordinarily high quality recycled water that benefits downstream, recreational users and the environment.

Green Business Award

Green business awards are designed to commend businesses and organizations that have made a contribution to environmental protection.

[*] For a copy of the "First Annual Joint Center Sustainable Community Award Winners 1999: Outstanding City/County Collaborations" call Kimberly Peterson at (202) 861-6784 or visit the website at www.usmayors.org/sustainable

The Federal EPA administers such a program, and encourages follow up activities such as a conference or festival to exhibit practices from award winning organizations so that industries can learn from each other. Awards are given in five areas: Environmental Planning and Management, Promotion of Waste Reduction, End-of-Pipe Treatment Results, Waste Treatment and Final Disposal, and Promotion of Environmental Concepts and Education. The goal of the program is to encourage innovative pollution prevention techniques and other measures to improve environmental quality.

An example is the Sonoma Green Business Program in Sonoma County, California. This program is a collaborative effort between the county, the cities and business to create a unified program that streamlines environmental requirements for the business community and provides incentives to businesses for sustained environmental compliance. Components of the program include: a regionalized, environmental regulatory approach; a focus on business education rather than enforcement; and a cooperative, coordinated program between businesses and regulators.

Education

The Wappinger Creek Watershed Planning Committee has identified education as one of the most important components of a watershed planning strategy. In the five years since the program was initiated, education has been on going at several levels. Displays have been presented at the annual Wappinger Creek Canoe Derby, educational workshops for volunteer stream stewards and local officials have been presented, the Watershed Watch school stream monitoring program has been supported, and brochures and flyers on the Watershed, streamside management and wetland protection have been developed.

At the November 1998 Watershed Conference a number of new projects were suggested that will take the education program into the implementation phase of this Management Plan. These projects are summarized here.

Community Networking

- Develop a centralized source such as a non-profit group or regional agency to distribute information and curriculum about the watershed.
- Establish a network among community groups by creating a Wappinger Creek Resource Partner Book that describes each organization and how to contact them.

Public Education

- Develop routine methods to educate new landowners about water issues. For example provide realtors with brochures already available from the EMC and SWCD titled, "What is a Wetland?", "Reducing Nonpoint Source Pollution", "Streamside Protection for Landowners" and "The Wappinger Creek Watershed".
- Develop an interesting, hands-on display and accompanying presentation that could travel with staff or volunteers to public places such as malls, festivals, community days, teen centers, churches, senior centers or scout meeting places. Include what a watershed is, how they affect the watershed in their daily lives, and what they can do to help improve water quality.
- Create a video based on the hands-on display and presentation that could be purchased or loaned out to school and community groups.
- Provide workshops for local officials and landowners about the importance of open space and how it affects the tax base, the importance of agriculture and a healthy forest, and existing NYSDEC regulations.
- Present information on water quality and water quantity to chambers of commerce.
- Have a "Wappinger Creek Watershed Week" in late April or early May with various events planned and corporate sponsors.
- Advertise the benefits and values of the Wappinger Creek by publishing maps, guides and telephone numbers for stream information in local newspapers and magazines.

- Establish contact with streamside homeowners. Inform them about the importance of vegetated buffers and involve them in community restoration efforts.
- Develop an outreach program to educate homeowners about how their actions can lead to loss of habitat and damage the ecology of our natural systems. Provide economic incentives such as the Wetland Reserve Program* for homeowners to not only protect habitat but to restore it.
- Implement neighborhood workshops focusing on integrated pest management, best management practices for lawn care, maintenance of riparian buffers (vegetation along streams), and wetland protection to reduce pollutant loading from pesticides, toxins, sediment and nutrients.

School Programs

- Promote use of a recently developed Watershed Education for Teachers booklet developed by the Board of Cooperative Educational Services (BOCES) and several local teachers. The booklet gives the rationale for using the material to comply with state standards and provides practical hands-on activities.†
- Encourage use of the Small Watershed Assessment Program, a watershed curriculum for four Dutchess County watersheds developed by the Institute of Ecosystem Studies in Millbrook.‡
- Encourage the use of a watershed curriculum guide developed by Cornell University, titled *Watershed Science for Educators*[73].
- Develop a Wappinger Creek Watershed training guide for schools based on the data and information in the Wappinger Creek Watershed Management Plan.
- Provide seminars and workshops for training teachers so they are more comfortable with the vast technical information available to them. Use the tools noted above for the workshops. Explore partnering with other organizations such as BOCES, Hudson Basin River Watch, and IES to sponsor the programs.
- Send out a teacher survey asking what they currently teach related to watershed protection and what they would like to have available. Based on the response, recommend the resources noted above or develop additional materials to meet their needs.
- Work at the state level to integrate environmental education into the base curriculum for public schools in a practical and creative way. Encourage or mandate the state board of public education and local school boards to add to programs and provide more time, funding and encouragement for environmental education.
- At the grade school level teach children to educate other children and their parents about environmental protection. One example is children encouraging their parents to use the town transfer station instead of cluttering roadsides with debris.

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* Wetland Reserve program – see Chapter IV (Incentives) for an explanation

† Contact Norene Coller, EMC Member-at-Large, (914) 889-4016.

‡ Call the Institute of Ecosystem Studies Education Program at (914) 677-9643

VII. Recommendations for Amending or Adopting Land Use Plan/Zoning Provisions

Importance of Intermunicipal Cooperation

There are thirteen communities within the boundaries of the Wappinger Creek Watershed (Table 2). Since water resources do not recognize political boundaries, each community is dependent on the others to maintain water quality. Seventy-five percent of the communities depend on the groundwater for drinking, and many of the public water supply wells are hydrologically connected to the Wappinger Creek or one of its tributaries. Examples include the Village of Millbrook wells located on a tributary to the East Branch of the Wappinger Creek and the Village of Wappingers Falls wells on the north shore of Wappingers Lake.

The thirteen watershed communities have recognized the necessity of working cooperatively since 1995, when the first watershed-wide workshop was held at the Farm and Home Center in Millbrook. The 1998 Watershed Conference at the Thorne Building in Millbrook continued discussions and information sharing between local leaders and residents. Most recently, the Land Use Law Center at Pace University School of Law set the intermunicipal cooperation program into higher gear when it conducted the Community Leadership Alliance (CLA) for community leaders in 1999.

At the completion of the CLA program, thirty-four local leaders from the region agreed to meet once more to prepare a grant application for expansion and implementation of the Watershed Management Plan. The communities requested and received state aid in the amount of $50,000 (which will be matched with local funds also amounting to $50,000). Twelve communities passed resolutions supporting the grant program and an intermunicipal organization. The draft mission statement of the intermunicipal organization is: "To share a number of common goals including the prevention of non-point source pollution of the watershed, the remediation of existing pollution, the preservation of open space, and natural resources and the expansion of economic activities consistent with the watershed environment."

Land Use Regulation Analysis

To provide background to the intermunicipal organization for recommendations on amending land use plans or controls at the local level, the Wappinger Creek Watershed Planning Committee worked with the Land Use Law Center at Pace University School of Law to compile a "Watershed Analysis", which is an inventory of rules and regulations in the 13 municipalities relating to watershed management. This analysis was described earlier in Chapter 2; see Appendix 8 for the Land Use Regulations Comparison Chart and an example of the "Watershed Template" for the Town of Clinton.

Land use practices in each municipality affect the watershed, thereby affecting the other twelve municipalities. Without a comprehensive watershed plan and intermunicipal cooperation, a single community will not be able to preserve their important water resources. The watershed planning team recommends that the comparison chart, watershed template, and land use diagnosis for each municipality be used to prepare an in-depth analysis of land use regulations across municipal boundaries.

Note: Additional analysis of the land use regulations in each municipality will be completed in 2000 and 2001 under the state grant mentioned in this section, along with a build-out analysis in GIS format to provide background on the impact of present zoning on natural resources.

VIII. Funding Sources and Implementing Agencies

This Watershed Management Plan would not have been possible without the support of federal, state, county and nonprofit funding sources. The Wappinger Creek Watershed Planning Committee, the Dutchess County Environmental Management Council (EMC) and the Dutchess County Soil & Water Conservation District (SWCD) received three major grants from 1995 to 1999 to support this project:

- Open Space Institute/Rural New York Grant Program - $2,500 for a land use inventory in GIS format
- Federal Environmental Protection Agency - $60,210 Wetland and Watershed Planning Project
- NYS Department of Environmental Conservation - $50,612 for Watershed Planning

As well as these grant programs, Dutchess County has provided local government support for five years by funding the EMC, SWCD and Cornell Cooperative Extension of Dutchess County. These agencies have provided administrative staff, office space, supplies, and vehicles for field work which have been used as the mandatory local match for the grant programs.

Marist College and the Institute of Ecosystem Studies have also provided support from the non-profit sector by offering laboratory facilities and professional expertise for the water quality monitoring program.

Two additional grants have been received in the year 2000 to expand on the land use regulations analysis in the management plan and to implement selected areas of the plan:

- NYS Department of State – $50,000 for an Intermunicipal Waterbody Management Plan for the Wappinger Creek Watershed
- Hudson River Estuary Program - $44,000 Watershed Education and Implementation Project

To provide continued support for implementation of this Management Plan, a list of federal, state and nonprofit agencies that offer grants and loans for water quality improvement and watershed planning projects is provided in this section. The following is a list of programs available as of the date of this Management Plan, however keep in mind that programs are always subject to changes in budgets and leadership at both the federal and state level. For addresses and telephone numbers of the sponsoring agencies please see Appendix 4.

Federal Sources

- Safe Drinking Water Act (SDWA) - Federal grants to states to support drinking water programs that protect public health and ensure compliance with the requirements of the SDWA.
- Clean Water Act - Section 319 (Nonpoint Source Pollution Management) provides grants to states for nonpoint source control projects; Section 104(b)(3) provides grants to states and local governments for wetland improvement projects (administered by the EPA)
- USDA-Rural Development - Drinking water & wastewater disposal loan and grant program provides financial assistance to villages, towns, counties and cities with a population of less than 10,000
- U.S. Department of Housing and Urban Development - Community Development Block Grants/Small Cities Program - provides grants to units of local government with a population of less than 50,000 for water and sewer projects
- USDA-Natural Resources Conservation Service - see ***Incentives*** section on page 100.

State Sources

- NYS Department of Environmental Conservation Nonpoint Source Management Program - funded by the 1996 Clean Water/Clean Air Bond Act and Section 319 of the Clean Water Act
- NYS Soil & Water Conservation Committee/NYS Department of Agriculture and Markets - Agricultural Nonpoint Source Abatement and Control Program - funded by the 1996 Clean Water/Clean Air Bond Act and the Environmental Protection Fund

- NYS Department of State Local Waterfront Revitalization Program - funded by the Environmental Protection Fund
- NYS Environmental Facilities Corporation - Clean Water State Revolving Fund - Provides loans for planning, design and construction of water pollution control projects
- NYS Department of Health/Environmental Facilities Corporation - Drinking Water State Revolving Fund - Provides loans for rehabilitation or development of new drinking water sources to replace contaminated supplies and installation or upgrading of drinking water system components
- Empire State Development - Infrastructure Development Financing
- NYS Energy Research and Development Authority - Energy Efficient Wastewater Treatment and Sludge Management Technologies Grants

Non-Profit Sources

- River Network - Watershed Assistance Grants
- Rural New York Grant Program - This program is presently being re-evaluated; contact the Open Space Institute for more information
- Hudson River Improvement Fund - Guidelines vary each year, but this fund occasionally offers grants for projects on tributaries to the Hudson River

For more information about funding sources, grant deadlines and resource information for applications contact the Dutchess County Environmental Management Council and the Dutchess County Soil and Water Conservation District (see Appendix 4 for addresses).

IX. Implementing Strategy

The Wappinger Creek Watershed Planning Committee and the watershed partners are committed to carrying out implementation of this Watershed Management Plan. Over the next year, grants from the NYS Department of State and the Hudson River Estuary Program will begin the implementation process. However, the WCWPC should continue to research funding sources and increase involvement by watershed partners.

Throughout this Management Plan, research needs and information gaps have been noted. In particular, more research is needed on wetlands identified for protection in Chapter VI. A streambank erosion study initiated in summer of 2000 should be completed to provide a basis for riparian buffer enhancement projects. The lake monitoring pilot study on Long Pond should be expanded to include all lakes in the watershed. Funding should be obtained to complete the watershed-modeling project for all subwatersheds. A cumulative impact analysis of SPDES discharge sites along the Wappinger Creek and into Wappingers Lake should be done including total loading of nutrients. Based on the results of the cumulative impact study, the Watershed Planning Team should work with the NYSDEC to reduce these inputs. A groundwater study including the interaction of nonpoint source pollution between surface and groundwater has also been identified by the watershed municipalities as top priority. Finally, the watershed municipalities have identified the need for training in land use techniques that will encourage sustainable communities.

One of the key components of implementation of this Management Plan is public involvement. Therefore the watershed planning team recommends that public outreach and education be continued for a wide diversity of audiences. Most important, the local boards in watershed municipalities should be involved in the process of implementation through the Intermunicipal Council and the Wappinger Creek Watershed Planning Committee.

The watershed planning team looks forward to working with municipalities, community groups, businesses and residents in implementation of this Management Plan. For more information about the information in this Plan or to submit suggestions and comments, please contact the Dutchess County Environmental Management Council at (914) 677-5253 or the Dutchess County Soil and Water Conservation District at (914) 677-8011.

X. Implementation Schedule

(This Schedule is based on the NYS Department of State Grant Awarded in February 2000)

Task A: Form an Intermunicipal Organization	
Intermunicipal Organization Formation	July 2000-November 2000
Task B: Hire a Project Administrator	September 2000
Task C: Inventory and Build-out Analysis	
Hiring of GIS Technician	March 2000
Training sessions for data collection	September -October 2000
Conduct Build-out Analysis for the first four towns	September 2000 - February 2001
Conduct Build-out Analysis for the remaining towns (dependent on funding)	May 2001 - April 2002
Task D: Identify Critical Water Quality Projects	
Identify projects and apply for funding for the first four towns	September 2000 - November 2000
Implement projects for the first four towns	April 2001-March 2002
Identify projects and apply for funding for the remaining towns	April 2001 - August 2001
Implement projects for the remaining towns	November 2001 - December 2003
Task E: Water Quantity Study	
Identify funding sources	September 2000
Select a consultant	December 2000
Consultant conducts the Water Quantity Study	2001
Task F: Retain Conservation Design Consultant	
Consultant for the first seven towns	2001 (Dependent on funding)
Consultant for the second seven towns	2001 (Dependent on funding)
Task G: Education	
Stream Care Guide Development	Fall, 2000
Present Build-out Analysis to first four towns	Spring, 2001
Present Build-out Analysis to remaining towns	2002
Train-the-trainer materials developed for CACs	2001
School Education Programs (on-going)	2000-2002
Public participation	
Task H: Implement Watershed Management Plan	
Develop an implementation strategy and schedule	August 2000-October 2000
Present Plan at Public Meetings	1999 (presented in draft form for comments) - 2002

GLOSSARY

Acidity - A condition of water when the pH is below 7. See pH.

Alkalinity - A condition of water when the pH is above 7. See pH.

Aquifer – Any soil or rock formation that contains water and permits sufficient water movement to yield water to wells and springs.

Bedrock - The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Benthic – Pertaining to the bottom (bed) of a water body.

Best Management Practice – An activity or structure that prevents or reduces the availability, release or transport of substances which adversely affect surface and ground waters. A management practice is a means of achieving desired results, whether it is implemented by a private, commercial or governmental entity, and whether through voluntary action, financial incentives, or regulatory requirements.

Biotic Index – A catalogue or index, which pertains to aspects of life, especially to characteristics of entire populations or ecosystems.

Drainage basin - See Watershed

Eutrophication - The process whereby an aquatic system acquires a high concentration of plant nutrients such as nitrogen and phosphorus and supports high plant productivity, caused either by pollution or natural processes.

Erosion - The wearing away of the land surface by running water, waves, moving ice and wind, or by other geological processes.

Fecal coliform bacteria - A group of bacteria present in fecal wastes. If found in water, the water is likely unsafe to drink because of the possible presence of disease-causing bacteria.

Filtering collector - A type of benthic macroinvertebrate with adaptations for capturing fine particles of organic matter from flowing water.

Fry – A small fish, especially a young, recently hatched one.

Gathering collector – A type of benthic macroinvertebrate with mouthparts and appendages designed for gathering small sediment deposits from the stream bottom or other substrates.

Gneiss - A coarsely banded metamorphic rock, often consisting of alternating light and dark colored bands.

Groundwater – Water beneath the surface of the land that completely fills the spaces between the grains of gravel, sand, silt and clay and cracks within rocks (known as the saturated zone). In the saturated zone water pressure is great enough to allow water to enter wells.

Host Organism- An organism that harbors a parasite and provides it with nourishment.

Impoundment – The act of accumulating water into a reservoir (a dam).

Macroinvertebrates – Organisms that lack a backbone and can be seen with the naked eye.

Metamorphic rocks - Rocks that have been changed in texture, mineralogy, and/or composition by the action of heat, pressure, or chemically active solutions.

Nonpoint source pollution - Pollution of waters caused by rainfall and snowmelt moving across and below the ground; as this water moves through the soil it carries pollutants from various land uses and deposits them into streams, lakes, and wetlands. Atmospheric deposition (acid rain) and hydrologic modification (dams and control structures) are also considered to be nonpoint source pollutants.

Nutrients - Nitrates and phosphates required by plants for growth; in excess nutrients can cause undesirable growth of aquatic plants and algae. Sources include runoff from fertilized cropland, animal manure, lawns, gardens, golf courses and septic systems.

Organic matter - Material derived from the decay of living organisms

pH - A measure of the acidity or alkalinity of water. Below 7 is acid, above 7 is alkaline.

Point source pollution - Pollutants that enter waterways by flowing directly out of a conveyance (pipe or storm sewer), and are subject to federal permit requirements.

Poughquag quartzite - A compact, hard metamorphic rock containing more than 90% quartz. This is created by the metamorphism of a quartz rich sandstone.

Precipitation - Condensed water vapor that falls to earth as rain, sleet, snow, or hail.

Riparian buffer – An area of trees, shrubs and / or grasses located adjacent to and up-gradient from water bodies.

Sedimentary rocks - Rocks composed of cemented particles (sediment) or of minerals deposited from water at relatively low temperatures.

Spring - A place on the earth's surface where ground water emerges naturally.

Taxa - A group of organisms sharing common characteristics, which are put into categories using the taxonomic classification system.

Watershed - All the land area which contributes surface and ground water to a particular lake, stream or river. A drainage basin is another term for a watershed.

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This plan would not have been possible without the support of various local, state and federal agencies. The Dutchess County Environmental Management Council, the Dutchess County Soil and Water Conservation District and Cornell Cooperative Extension Dutchess County contributed staff and materials for the research and preparation of the document. Several grants were awarded over the four-year period by the United States Environmental Protection Agency Wetlands Demonstration Program, the New York State Department of Environmental Conservation Watershed Planning Program, the New York State Environmental Protection Fund, and the Rural New York Grant Program. We are also grateful for the research on land use laws in the watershed municipalities and the Community Leadership Alliance training program provided by the Land Use Law Center at Pace University School of Law and the Glynwood Center. Assistance, facilities and equipment for the water quality monitoring program were provided by Marist College, the Institute of Ecosystem Studies, Mid-Hudson Trout Unlimited and the Dutchess County Department of Health. Facilitation skills for the 1998 Watershed Conference were provided by the ImpAct Company.

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Appendix 1: Acronyms

avg. = average
cc. = cubic centimeter
cm. = centimeter
deg. = degree
gm. = gram
gpm = gallons per minute
gpd = gallons per day
gph = gallons per hour
hr. = hour
l = liter(s)
ml = milliliter(s)
mg/l = milligrams per liter
ppb = parts per billion
ppm = parts per million

AEM = Agricultural Environmental Management Program
AU = Animal Unit (1 AU = 1000 lbs. Animal)
BMP = Best Management Practice
CAFO = Concentrated Animal Feedlot Operation
CCE = Cornell Cooperative Extension
CRP = Conservation Reserve Program
CWA = Clean Water Act
CWQCC = County Water Quality Coordinating Committee
DA&M = Department of Agriculture and Markets
DEC = Department of Environmental Conservation
DOH = Department of Health
DOS = Department of State
EAF = Environmental Assessment Form
EIS = Environmental Impact Statement
EMC = Environmental Management Council
EPA = Environmental Protection Agency
EPF = Environmental Protection Fund
EQIP = Environmental Quality Incentives Program
FEMA = Federal Emergency Management Administration
FIP = Forestry Incentives Program
FLPP = Farm Land Protection Program
FSA = Farm Service Agency
GIS = Geographic Information System
IES = Institute of Ecosystem Studies
LPA = Local Priority Area
NPS = Nonpoint Source
NRCS = National Resources Conservation Service
NYSDEC = New York State Department of Environmental Conservation
PWL = Priority Waterbody List of the NYSDEC
RIBS = NYSDEC Rotating Intensive Basin Study
RMS = Resource Management System
SDWA = Safe Drinking Water Act
SEQR = State Environmental Quality Review
SEQRA = State Environmental quality Review Act
SIP = Stewardship Incentives Program
SPDES = State Pollution Discharge Elimination System
SWCC = Soil and Water Conservation Committee
SWCD = Soil and Water Conservation District
USDA = United States Department of Agriculture
USGS = United States Geological Survey
WFP = Whole Farming Program
WSP = Water Supply Protection
WHIP = Wildlife Habitat Incentives Program
WRP = Wetlands Reserve Program

Appendix 2: Priority Water Body Summary Sheets

DUTCHESS COUNTY 1996 PWL UPDATE PRIORITY WATERBODY LIST

SEGMENT NAME	SEG ID	COUNTY	SEGMENT TYPE	SEGMENT SIZE	CLASS	PRIMARY USE IMPAIRED	SEVERITY	PRIMARY POLLUTANT	PRIMARY SOURCE
DUCHESS LAKE	1302-0030	Dutchess	Lake	45.0 A	B	Boating	Threatened	Nutrients	On-site Systems
FALLKILL CREEK	1301-0087	Dutchess	River	20.0 Mi.	C	Fishing	Stressed	Pathogens	On-site Systems
FISHKILL CREEK	1304-0003	Dutchess	River	5.0 Mi.	C	Fishing	Stressed	Pathogens	Urban Runoff
HILLSIDE LAKE	1304-0001	Dutchess	Lake	26.0 A	B	Bathing	Stressed	Nutrients	On-site Systems
HUDSON RIVER	1301-0003	Dutchess	Estuary	59574.0 A	A	Fishing	Impaired	Priority Organics	Contaminated Sed.
HUNNS LAKE	1305-0004	Dutchess	Lake	70.0 A	B	Bathing	Stressed	Nutrients	On-site Systems
HUNNS LAKE CREEK	1305-0011	Dutchess	River	3.0 Mi.	C(T)	Water Supply		Oxygen Demand	Agriculture
LONG POND	1305-0003	Dutchess	Lake	83.0 A	AA	Boating	Stressed	Nutrients	On-site Systems
MORGAN LAKE	1301-0039	Dutchess	Lake	13.0 A	C	Fish Survival	Stressed	Silt (Sediment)	Urban Runoff
SAW KILL CREEK	1301-0085	Dutchess	River	4.0 Mi.	B(T)	Fish Propagation	Stressed	Nutrients	On-site Systems
SILVER LAKE	1305-0002	Dutchess	Lake	102.0 A	AA(T)	Boating	Stressed	Nutrients	On-site Systems
STONY CREEK	1301-0086	Dutchess	River	2.0 Mi.	D	Aesthetics	Threatened	Nutrients	Urban Runoff
TWIN ISLAND POND	1305-0010	Dutchess	Lake	0.0 A	B	Bathing	Stressed	Nutrients	Other Source
UPTON LAKE	1305-0005	Dutchess	Lake	45.0 A	B	Bathing	Stressed	Nutrients	On-site Systems
WAPPINGERS LAKE	1305-0001	Dutchess	Lake	104.0 A	B	Bathing	Impaired	Nutrients	Urban Runoff

DUTCHESS COUNTY 1996

SEGMENT ID: 1305-001
OLD PWP ID: 102
WAPPINGERS LAKE

LOCATION INFORMATION **Revised: 04/19/96**

Basin:	13- Lower Hudson River	**Stream Class:**	B
Sub-Basin:	05- Wappinger Creek	**7Q10 Flow:**	> 150 cfs
Seg Type:	Lake	**Segment Priority:**	1
Reg/County:	3/Dutchess (14) County		
Quad Map:	0-25-4		
Quad Name:	WAPPINGER FALLS, NY		
Affected Area:	104.0 Acres		
Description:	Entire Lake (AND ENTIRE LENGTH OF THE WAPPINGERS CREEK)		

PROBLEM INFORMATION

Use Impairment (s)	**Severity**	**Documentation**
BATHING	IMPAIRED	Some ← Primary Impairment
FISHING	STRESSED	Good
FISH PROPAGATION	STRESSED	Good
AESTHETICS	STRESSED	Good
BOATING	STRESSED	Good

Type of Pollutant (s)	**(PRIMARY/Other)**	
NUTRIENTS	Silt (Sediment)	Oxygen Demand
Salts	Thermal Changes	Pathogens
Aesthetics		

Source (s) of Pollutant (s)	**(PRIMARY/Other)**	
URBAN RUNOFF	Agriculture	Construction
Storm Sewers	De-icing Agents	Streambank Erosion
Roadbank Erosion		

Resolvability

Issue Needs Study and Management Plan

TMDL Notes

Development Possible, Resource Limitations

FURTHER DETAILS

Turbidity and dense aquatic vegetation impairs the bathing use in the lake. (Secchi disk readings less than 2 meters). A harvester is used to control the aquatic vegetation to allow reasonable access. There is a massive amount of silt in the lake from upstream segments. The lake is a sink for the watershed. The Wappingers Creek Watershed has experienced substantial urbanization. The entire length of the creek is impaired/stressed for a variety of it's best uses.
Additionally, remaining agriculture in the watershed contributes to the water quality impairments.

Trophic level: Eutrophic
Pond # : 13 365

DUTCHESS COUNTY 1996

Segment ID: 1305-0005
Old PWP ID: 868
UPTON LAKE

LOCATION INFORMATION **Revised**: 04/19/96

Basin:	13- Lower Hudson River	Stream Class:	B
Sub-Basin:	05-Wappinger Creek	7Q10 FLOW:	> 150 cfs
Seg Type:	Lake		
Reg/County:	3/Dutchess (14) County	Segment Priority: 3	
Quad Map:	N-25-3		
Quad Name:	SALT POINT		
Affected Area:	45.0 Acres		
Description:	Entire Lake		

PROBLEM INFORMATION

Use Impairment (s)	**Severity**	**Documentation**
BATHING	STRESSED	Some ← Primary Impairment

Type of Pollutant (s) (PRIMARY/Other)
NUTRIENTS

Source (s) of Pollutant (s) (PRIMARY/Other)
ON-SITE SYSTEMS

Resolvability
Condition Needs Verification

FURTHER DETAILS

Nutrient loading from on-site wastewater systems promotes aquatic vegetation. The extensive aquatic vegetation interferes with bathing.
Source of Information: Central Office, Water Quality Management

Was 1991 NPS #14-007 (1305-0009).

DUTCHESS COUNTY 1996

Segment ID: 1305-0003
Old PWP ID: 866
LONG POND

LOCATION INFORMATION **Revised:** 04/19/96

Basin:	13-Lower Hudson River	**Stream Class:**	AA
Sub-Basin:	05-Wappinger Creek	**7Q10 FLOW:**	> 150 cfs
Seg Type:	Lake		
Reg/County:	3/Dutchess (14) County	**Segment Priority:**	3
Quad Map:	N-25-2		
Quad Name:	ROCK CITY		
Affected Area:	83.0 Acres		
Description:	Entire Lake		

PROBLEM INFORMATION

Use Impairment (s)	**Severity**	**Documentation**
FISHING	STRESSED	Poor
BOATING	STRESSED	Poor ← Primary Impairment

Type of Pollutant (s) (Primary/Other)
NUTRIENTS

Source(s) of Pollutant(s) (Primary/Other)
ON-SITE SYSTEMS

Resolvability
Issue Needs Study and Management Plan

FURTHER DETAILS

Lake nutrients loads are increased (in part) due to on-site wastewater systems. Residences with failing or non-existent individual systems and groundwater leaching from these systems adds nutrients to the lake. Nutrient loads promote the extensive growth of aquatic vegetation which interferes with boating and fishing.

Source of Information: Central Office, Water Quality Management

Was also 1991 NPS # 14-002 (1305-0007).

DUTCHESS COUNTY 1996

Segment ID: 1305-0011
Old PWP ID:
HUNNS LAKE CREEK

LOCATION INFORMATION **Revised:** 04/22/96

Basin:	13-Lower Hudson River	**Stream Class:**	C(T)
Sub-Basin:	05-Wappinger Creek	**7Q10 Flow:**	<20 cfs
Seg Type:	River		
Reg/County:	3/Dutchess (14) County	**Segment Priority:**	2
Quad Map:			
Quad Name:	PINE PLAINS		
Affected Area:	3.0 miles		
Description:	From Hunns Lake to Bangall		

PROBLEM INFORMATION

Use Impairment (s)	**Severity**	**Documentation**
FISHING	STRESSED	Good
FISH PROPAGATION	STRESSED	Good
FISH SURVIVAL	STRESSED	Good

Type of Pollutant(s)	(PRIMARY/Other)	
OXYGEN DEMAND	Pesticides	Nutrients
Silt (Sediment)	Pathogens	

Source (s) of Pollutant (s)	(PRIMARY/Other)
Agriculture	Streambank Erosion

Resolvability
Can Be Handled by External Agencies

FURTHER DETAILS

Primary problems are farm animals with access to the s tream. In these areas the streambanks are bare and eroding. On the uplands, the majority of the crop fields are eroding at excessive levels and nutrient management does not account for the volume of phosphorus used.

*
Segment was added by the Dutchess County Water Quality Committee.

DUTCHESS COUNTY 1996

Segment ID: 1305-0002
Old PWP ID: 865
SILVER LAKE

LOCATION INFORMATION **Revised:** 04/19/96

Basin:	13-Lower Hudson River	**Stream Class:**	AA(T)
Sub-Basin:	05-Wappinger Creek	**7Q10 FLOW:**	>150 cfs
Seg Type:	Lake		
Reg/County:	3/Dutchess (14) County	**Segment Priority:**	1
Quad Map:	N-25-2		
Quad Name:	ROCK CITY		
Affected Area:	102.0 Acres		
Description:	Entire Lake		

PROBLEM INFORMATION

Use Impairment (s)	**Severity**	**Documentation**
FISHING	STRESSED	Poor
BOATING	STRESSED	Poor ← Primary Impairment

Type of Pollutant (s) (PRIMARY/Other)
NUTRIENTS

Source (s) of Pollutant (s) (PRIMARY/Other)
ON-SITE SYSTEMS

Resolvability
Condition Needs Verification

TMDL Notes
Problem Not Amenable

FURTHER DETAILS

Lake nutrient loads are increased due to on-site wastewater systems. Failing or non-existent individual systems and groundwater leaching from these systems adds nutrients to the lake. Nutrient loads promote the extensive growth of aquatic vegetation which impairs boating.

Source of Information: Central Office, Water Quality Management

Was also 1991 NPS # 14-001 (1305-0006).

DUTCHESS COUNTY 1996

Segment ID: 1305-0010
Old PWP ID:
TWIN ISLAND POND

LOCATION INFORMATION

Revised: 04/22/96

Basin:	13- Lower Hudson River	**Stream Class:**	B
Sub-Basin:	05-Wappinger Creek	**7Q10 FLOW:**	> 150 cfs
Seg Type:	Lake		
Reg/County:	3/Dutchess (14) County	**Segment Priority:**	3
Quad Map:			
Quad Name:	PINE PLAINS		
Affected Area:	0.0 Acres		
Description:	Entire Lake		

PROBLEM INFORMATION

Use Impairment (s)	**Severity**	**Documentation**
BATHING	STRESSED	Poor ← Primary Impairment
AESTHETICS	STRESSED	Poor
BOATING	STRESSED	Poor

Type of Pollutant (s) (PRIMARY/Other)
NUTRIENTS

Source(s) of Pollutant (s) (PRIMARY/Other)
OTHER (Waterfowl)

Resolvability
Condition Needs Verification

FURTHER DETAILS

Substantial weed growth stress bathing use and aesthetics of the lake. Waterfowl appear to be the source of the nutrient enrichment.

*Segment was added by the Dutchess County Water Quality Committee.

DUTCHESS COUNTY 1996

Segment ID: 1305-0004
Old PWP ID: 867
HUNNS LAKE

LOCATION INFORMATION

Revised: 04/19/96

Basin:	13-Lower Hudson River	**Stream Class:**	B
Sub-Basin:	05-Wappinger Creek	**7Q10 FLOW:**	>150 cfs
Seg Type:	Lake		
Reg/County:	3/ Dutchess (14) County	**Segment Priority:**	1
Quad Map:	N-26-1		
Quad Name:	PINE PLAINS		
Affected Area:	Entire Lake		

PROBLEM INFORMATION

Use Impairment(s)	**Severity**	**Documentation**
BATHING	STRESSED	Some ← Primary Impairment

Type of Pollutant (s)	**(<u>PRIMARY</u>/Other)**
<u>NUTRIENTS</u>	Silt (Sediment)

Source(s) of Pollutant(s)	**(PRIMARY/Other)**
<u>ON-SITE SYSTEMS</u>	Agriculture

Resolvability
Can Be Handled by External Agencies

FURTHER DETAILS

Poor on-site systems and cropland runoff have been tentatively identified as the nutrient sources that have resulted in fairly heavy weed growth in the lake. The heavy weed growth interferes with the bathing use of portions of the lake.

Source of Information: Central Office, Water Quality Management

Was also 1991 NPS # 14-006 (1305-0008).

Appendix 3: Public Water Supplies with Elevated Nitrate Levels 1993-1995

Public Water Supplies with Nitrate Violations

Fed #	System Name:	Sampled:	Analyte:	Amount:	Units:	Town	Section	Map	Grid
1302114	ROBERT'S MOBILE HOME PARK	6/13/95	NO_3	16.30	mg/L	19	6358	03	288170
1302124	ENNIS PARC	2/17/94	NO_3	12.20	mg/L	13	6363	03	459186
1302133	PHILLIPS TRAILER PARK	11/16/94	NO_3	11.00	mg/L	01	7064	02	678803
1302141	FOXWELL TERRACE MHP	7/26/93	NO_3	15.20	mg/L	04	7160	01	439751
1302146	SHADY HOMES TRAILER PARK	4/20/95	NO_3	11.20	mg/L	04	7059	04	817437
1302157	BECKWITH TP	3/16/95	NO_3	10.50	mg/L	13	6363	04	549149
1302163	AUNT GERT'S MOBILE HOME PARK	2/8/95	NO_3	19.90	mg/L	20	7064	18	391054
1303217	CLOVE BRANCH APARTMENTS	12/1/94	NO_3	24.70	mg/L	05	6458	04	887068
1303221	FRANTONI VILLAS	1/26/95	NO_3	24.70	mg/L	07	6163	02	548915
1313460	KNOLLWOOD MOTOR INN	3/15/93	NO_3	11.70	mg/L	05	6456	02	678668
1316155	BEEKMAN ELEMENTARY SCHOOL	6/4/93	NO_3	12.30	mg/L	02	6758	00	100483
1316231	COLOSSEO RESTAURANT	11/18/94	NO_3	10.30	mg/L	11	7055	00	477834
1316249	GREENBAUM & GILHOOLEYS	3/17/93	NO_3	20.00	mg/L	19	6157	02	594684
1316603	FORD'S RESTAURANT & TAVERN	6/6/95	NO_3	12.60	mg/L	04	7060	04	924082
1316609	OLD DROVERS INN	1/26/95	NO_3	11.00	mg/L	04	7061	00	790875
1316682	RAY RENZO'S RESTAURANT	11/9/95	NO_3	12.50	mg/L	13	6363	04	511084
1316707	RED HOOK RHINEBECK ELKS LODGE	4/26/95	NO_3	13.20	mg/L	15	6273	00	707125
1321356	VILLAGE PARK APARTMENTS	5/24/95	NO_3	11.00	mg/L	13	6363	02	882902
1321381	HARLEM VALLEY VFW#5444	10/5/94	NO_3	11.50	mg/L	01	7064	19	541150
1321478	REAGANS MILL WATER COMPANY	3/22/93	NO_3	15.20	mg/L	04	7160	01	301633
1321645	RANDOLPH SCHOOL	3/16/92	NO_3	60.30	mg/L	19	6157	01	216814
1322627	DUTCHESS CO AIRPORT IBM #953	5/2/95	NO_3	20.40	mg/L	19	6259	03	225301
1322716	CONKLIN RESTAURANT	1/3/95	NO_3	105.00	mg/L	13	6363	01	355761
1322770	STORMVILLE TAVERN	12/21/93	NO_3	10.70	mg/L	05	6657	03	94258
1322776	FREEDOM BUSINESS CENTER	1/7/95	NO_3	10.50	mg/L	08	6460	02	521968
1325000	EXECUTIVE SQUARE	4/25/94	NO_3	24.40	mg/L	19	6157	02	608885
1330000	BEEKMAN PLAZA ROYALE	4/7/94	NO_3	12.60	mg/L	02	6658	00	507504
1330009	HOPEWELL RECREATION AREA	5/5/94	NO_3	17.20	mg/L	05	6457	03	453489
1330028	BURGER KING PAWLING	2/8/95	NO_3	17.80	mg/L	11	7056	00	494016
1330044	RAGANS MILL TRAILER PARK	2/6/95	NO_3	12.60	mg/L	04	7160	01	370726
1330058	CINNAMON TREE OF EAST FISHKILL	9/7/94	NO_3	12.60	mg/L	05	6456	01	249613
1330068	TOWNE CRIER CAFÉ	4/20/95	NO_3	16.60	mg/L	11	7055	00	496975
1330069	PIZZA VILLAGE	4/26/95	NO_3	14.20	mg/L	05	6457	01	221552
1330071	DUNKIN DONUTS, DAIRY MART	1/25/95	NO_3	13.20	mg/L	05	6457	01	240565
1330100	DUTCHESS CO AIRPORT TERMINAL	1/16/95	NO_3	21.90	mg/L	19	6259	03	225301
1330116	IL COMPARE RESTAURANT	1/26/95	NO_3	12.90	mg/L	04	7160	00	226426
1330139	COUNTRY BEAR PRESCHOOL	12/14/95	NO_3	12.10	mg/L	11	7056	01	388588
1330152	PLEASANT VY. UNITED METHODIST	9/8/94	NO_3	31.80	mg/L	13	6363	12	852718
1330156	MERCHANTS PRESS	11/22/94	NO_3	12.60	mg/L	08	6361	03	028167
1330188	ELLIE'S INC.	12/8/94	NO_3	12.60	mg/L	02	6658	00	507504
1330193	MCCORMACK'S OUTBACK INN	11/16/94	NO_3	10.30	mg/L	13	6465	02	788767
1330194	EAST FISHKILL TOWN HALL	6/15/95	NO_3	12.60	mg/L	05	6457	03	401388
1330201	LAKESIDE ACRES (KIRVENS)	1/26/95	NO_3	23.00	mg/L	17	6869	15	745399
1330210	BLUE FOUNTAIN REST.	6/13/95	NO_3	11.80	mg/L	05	6358	02	964517
1302108	WAPPINGER FALLS TRAILER PARK	8/3/93	NO_3	5.75	mg/L	19	6158	02	700710
1302115	POWELL ROAD MOBILE PARK	1/24/95	NO_3	8.71	mg/L	04	7063	00	765454
1302119	COUNTRY ACRES MOBIL HOME PARK	3/2/94	NO_3	9.16	mg/L	13	6464	01	340540
1302127	CEDAR HOLLOW MOBILE HOME PARK	9/7/95	NO_3	8.10	mg/L	13	6464	01	429648

Fed #	System Name:	Sampled:	Analyte:	Amount:	Units:	Town	Section	Map	Grid
1302142	SABO TRAILER PARK	12/6/93	NO_3	6.92	mg/L	01	7067	00	229245
1302148	RAMSEY MOBILE HOME PARK	4/20/95	NO_3	9.57	mg/L	04	7059	04	790299
1302150	HILLTOP MHP	12/29/93	NO_3	7.76	mg/L	04	7160	01	370701
1302155	WAYSIDE TRAILER PARK	11/17/94	NO_3	9.55	mg/L	13	6363	04	674398
1302159	CARDINAL ROAD ESTATES	10/17/94	NO_3	7.96	mg/L	07	6165	04	563338
1302762	BRETTVIEW ACRES WATER CO.	12/28/94	NO_3	9.30	mg/L	05	6357	01	138700
1302763	HOPEWELL GARDENS	12/14/94	NO_3	5.90	mg/L	05	6457	04	549231
1302764	HOPEWELL SERVICES, INC.	11/21/95	NO_3	5.00	mg/L	05	6357	04	510428
1302783	WAPPINGER FALLS VILLAGE	2/16/95	NO_3	5.62	mg/L	14	6158	10	332590
1302785	PINEWOOD KNOLLS WATER DISTRICT	4/5/95	NO_3	6.46	mg/L	05	6458	04	861170
1302787	BEEKMAN COUNTRY CLUB	4/20/94	NO_3	6.90	mg/L	05	6558	03	295375
1302791	GRANDVIEW ESTATES	10/17/95	NO_3	5.90	mg/L	08	6560	04	946311
1302809	TALL TREES W.D.	11/28/94	NO_3	7.90	mg/L	19	6057	02	688546
1303219	ARBORS CONDOMINIUMS	5/25/94	NO_3	6.20	mg/L	07	6163	03	082461
1309296	ELLIOT APARTMENTS	5/23/95	NO_3	8.50	mg/L	08	6460	02	702756
1310659	MAY LANE MOBILE PARK	5/15/93	NO_3	9.80	mg/L	01	7064	19	627178
1310663	GREEN MEADOW TRAILER COURT	6/7/94	NO_3	7.40	mg/L	07	6164	04	662146
1310666	DAWN MOBILE HOME PARK	11/10/93	NO_3	10.00	mg/L	08	6562	02	648581
1310667	LAMPLIGHT COURT MOBILE ESTATES	10/20/94	NO_3	5.30	mg/L	15	6271	00	180845
1310669	BROOKS MOBILE HOME PARK	12/23/94	NO_3	5.75	mg/L	04	7059	00	534425
1312154	STORMVILLE STATE POLICE	4/6/93	NO_3	10.00	mg/L	05	6556	00	345281
1312420	SOMERSET LEISURE HOME, INC	5/19/94	NO_3	8.20	mg/L	02	6658	00	328614
1312428	INTERLAKE FARM CAMPGROUND	4/27/95	NO_3	6.92	mg/L	03	6469	00	218434
1312441	FRESH AIR FUND	2/17/94	NO_3	5.89	mg/L	06	6255	00	285110
1312444	VICTORY LAKE CAMP	9/23/94	NO_3	5.50	mg/L	07	6265	04	630350
1312463	BARDOS FISHKILL MIR INN CORP	4/17/93	NO_3	5.62	mg/L	16	6156	04	792114
1312469	EDISON MOTOR INN	3/29/93	NO_3	9.12	mg/L	08	6261	04	964395
1312479	CAMP GREEN ACRES	2/22/95	NO_3	6.61	mg/L	04	7061	00	357420
1312994	PEACH TREE PLANTATION	4/17/95	NO_3	7.59	mg/L	15	6175	00	942252
1316138	HICKORY HILL ESTATES	1/25/95	NO_3	7.08	mg/L		6363	01	414892
1316151	KILDONAN SCHOOL	4/14/93	NO_3	7.24	mg/L	10	7169	00	202068
1316220	STOCKYARD RESTAURANT	11/28/94	NO_3	7.24	mg/L	05	6457	01	470744
1316234	WHALEY LAKE INN	6/6/95	NO_3	7.59	mg/L	11	6857	18	307069
1316239	LA FONDA DEL SOL	2/14/95	NO_3	5.50	mg/L	19	6157	02	542585
1316254	PIZZA SHOPPE	5/4/95	NO_3	8.91	mg/L	06	6055	01	050614
1316595	THE LANTERN INN INC.	6/20/94	NO_3	6.00	mg/L	01	7165	01	094844
1316605	RIVERVIEW TAVERN	4/17/95	NO_3	7.08	mg/L	04	7160	03	285393
1316608	MARIO'S PIZZA REST.	10/19/94	NO_3	7.94	mg/L	11	7055	00	503941
1316623	PERRI'S VERBANK INN	6/20/95	NO_3	8.34	mg/L	18	6663	20	850083
1316645	LIA'S MT VIEW RESTAURANT	11/2/95	NO_3	5.00	mg/L	12	6871	00	360870
1316690	OLD HEIDELBERG	6/20/94	NO_3	7.80	mg/L	13	6464	04	888031
1316692	ROAD HOUSE TAVERN	1/25/95	NO_3	5.00	mg/L	13	6363	12	937621
1316693	BADGER & BADGER	10/19/95	NO_3	9.30	mg/L	13	6363	02	882505
1316696	VILLAGE RESTAURANT	1/19/95	NO_3	5.25	mg/L	13	6363	02	744508
1316697	MORSE'S TAVERN	3/10/93	NO_3	8.32	mg/L	13	6363	04	502011
1317607	ANGELS MOBILE HOME PARK	11/12/93	NO_3	7.94	mg/L	04	7059	00	542451
1319873	GRACIE TRAILER PARK	10/31/95	NO_3	5.00	mg/L	01	7064	00	628776
1321440	SQUIRE GREEN WATER CORPORATION	8/16/95	NO_3	5.20	mg/L	11	6957	02	632970
1321819	GRAND UNION PLAZA	4/20/94	NO_3	6.99	mg/L	05	6457	01	328570
1321942	COUNTRY COMMONS	12/31/94	NO_3	5.10	mg/L	13	6363	06	371806
1322160	LE CHAMBORD	4/7/94	NO_3	7.59	mg/L	05	6557	03	242048
1322377	NEW HACKENSACK NURSERY SCHOOL	3/17/93	NO_3	6.92	mg/L	19	6259	04	590205

Fed #	System Name:	Sampled:	Analyte:	Amount:	Units:	Town	Section	Map	Grid
1322379	HAPPY HOURS TOTAL CHILD CARE	10/5/94	NO_3	5.37	mg/L	05	6358	01	431579
1322380	SMALL WORLD CHILD CARE	2/1/95	NO_3	7.59	mg/L	05	6358	01	431579
1322382	ESTELLE AND ALFONSO CHILD CARE	7/27/95	NO_3	6.02	mg/L	06	6156	04	718417
1322427	CINNAMON TREE DAY CARE CENTER	12/6/94	NO_3	5.37	mg/L	08	6460	01	383982
1322428	CHILDREN'S HOUSE	12/8/94	NO_3	7.94	mg/L	08	6560	02	582930
1322514	TRINITY CHILDREN'S CENTER	12/8/94	NO_3	5.50	mg/L	08	6560	04	829294
1322547	BETHEL HOMEOWNER'S ASSOCIATION	7/15/94	NO_3	7.41	mg/L	12	6871	00	986200
1323016	US CABLEVISION	2/18/93	NO_3	8.13	mg/L	19	6157	02	539850
1330007	FUN CENTRAL	6/7/95	NO_3	7.94	mg/L	19	6158	04	548355
1330019	CEDAR KNOLLS TRAILER PARK	9/21/94	NO_3	6.03	mg/L	04	7060	00	712541
1330023	CUMBERLAND FARMS BEEKMAN	7/30/93	NO_3	6.17	mg/L	02	6759	00	422420
1330024	STANFORD NURSERY SCHOOL	9/29/94	NO_3	7.41	mg/L	17	6768	03	479417
1330030	CAMP WETHERSFIELD	6/27/95	NO_3	5.62	mg/L	17	6968	00	503457
1330048	VIRAS MHP	3/11/94	NO_3	8.71	mg/L	04	7059	04	764353
1330072	JUNIORS LOUNGE	12/28/94	NO_3	5.50	mg/L	07	6263	03	281312
1330080	INN AT THE FALLS	4/12/94	NO_3	5.13	mg/L	08	6260	04	615329
1330083	HYDE PARK NURSERY SCHOOL #1	12/19/94	NO_3	7.94	mg/L	07	6065	04	822335
1330091	RED HOOK COMMUNITY RESIDENCE	10/24/94	NO_3	5.25	mg/L	15	6373	00	218065
1330101	SPLASH DOWN PARK	5/24/95	NO_3	7.94	mg/L	06	6156	04	717443
1330102	HERITAGE HOLDING CO.	6/12/95	NO_3	9.60	mg/L	05	6457	01	255575
1330111	ESCAPE CLUB CAFÉ	3/3/95	NO_3	8.91	mg/L	15	6172	00	510900
1330121	VALEUR MANSION CATERING	9/9/94	NO_3	5.00	mg/L	16	6071	00	760181
1330124	DYNASTY CHINESE RESTAURANT	2/2/95	NO_3	9.35	mg/L	19	6157	04	638394
1330138	EDWARD R. MURROW PARK, DCOA	5/11/94	NO_3	8.34	mg/L	11	6957	00	700300
1330140	POT BELLY DELI	5/2/94	NO_3	8.32	mg/L	02	6759	00	386424
1330143	WHITE POND CENTER DAY CARE	5/3/95	NO_3	5.00	mg/L	05	6655	04	914189
1330144	PAWLING FIRE DEPARTMENT	2/8/95	NO_3	6.03	mg/L	11	6956	00	976613
1330154	INN AT OSBORNE HILL	6/3/95	NO_3	6.17	mg/L	19	6156	01	485668
1330160	QUAKER HILL COUNTRY CLUB	6/23/93	NO_3	9.33	mg/L	11	7157	00	507971
1330170	YOUNG JUDEA	6/21/95	NO_3	5.38	mg/L	18	6662	00	229857
1330192	EMERGENCY SERVICES BLDG	10/28/94	NO_3	6.20	mg/L	19	6157	01	353724
1330205	HOPEWELL ICE CREAM	4/5/95	NO_3	7.59	mg/L	05	6457	01	372658
1330219	WAPPINGER DAY CAMP	4/17/95	NO_3	5.00	mg/L	19	6157	01	353724

Appendix 4: Watershed Partners and Resource Agencies

(* Indicates partners)

***Aquatic Explorers**
c/o Joe Will
30 Thomas Ave.
Poughkeepsie, NY 12603

***Chazen Companies**
229 B Page Park
Manchester Road
Poughkeepsie, NY 12603
(845) 454-3980

***Cornell Cooperative Extension of Dutchess County**
Farm and Home Center
2715 Route 44, Suite 1
Millbrook, NY 12545
(845) 677-8223

Dutchess County Department of Parks, Recreation and Conservation
Bowdoin Park
85 Sheafe Road
Wappinger Falls, NY 12590
(845) 298-4600

Dutchess County Department of Planning and Development
27 High Street
Poughkeepsie, NY 12601
(845) 486-3600
Fax: (845) 486-3610
E-mail: dc2@idsi.net

***Dutchess County Department of Public Works (DPW) Highway Divisions Main Offices**
38 Dutchess Turnpike
Poughkeepsie, NY 12603
(845) 486-2900

Dutchess County Real Property Tax Service
County Office Building
22 Market Street
Poughkeepsie, NY 12601
(845) 486-2140

***Dutchess County Soil and Water Conservation District (SWCD)**
Farm and Home Center
P.O. Box 37
Millbrook, NY 12545
(845) 677-8011 Ext. 3
Fax: (845) 677-8354
e-mail: dutchess@ny.wacdnet.org
website: ny.nacdnet.org\dutchess

***Dutchess County Water and Wastewater Authority**
27 High Street
Poughkeepsie, NY 12601
(845) 486-3601
Fax: (845) 486-3610

***Dutchess County Water Quality Strategy Committee**
c/o Dutchess County Soil and Water Conservation District
Farm and Home Center
P.O. Box 37
Millbrook, NY 12545
(845) 677-8011 x 3

***Dutchess Land Conservancy**
Becky Thornton, Executive Director
RR 2 Box 13, Route 44 West
Millbrook, NY 12545
(845) 677-3002
email: dlc@bestweb.net

Environmental Law Foundation
Marilyn Reed Kelly, Executive Director
235 Main Street
New Paltz, NY 12561
(845) 255-0578

Environmental Planning Lobby
Lee Wasserman, Executive Director
33 Central Avenue
Albany, NY 12210
(518) 462-5526

Fish and Game Federation of Dutchess County
Rob Weiss, Board of Directors
P.O. Box 3201
Poughkeepsie, NY 12602
(845) 471-9790

Greenway Heritage Conservancy
William Janeway, Executive Director
Capitol Bldg, Room 254
Albany, NY 12224
(518) 473-3835
Fax: (518) 473-4518

***Hudson Basin River Watch**
229 Brownell Hollow
Eagle Bridge, NY 12057
(518) 677-5029

Hudsonia Limited
Bard College Field Station
Annandale, NY 12504
(845) 758-7273

e-mail: info@hudsonia.org

Hudson River Sloop Clearwater
Andy Mele, Executive Director
Manna Jo Greene, Environmental Director
112 Little Market Street
Poughkeepsie, NY 12601
(845) 454-7673
Fax: (845) 454-7953
website: www.clearwater.org

Hudson River Environmental Society
Stephen O. Wilson, Executive Director
6626 Stitt Road
Altamont, NY 12009
(518) 861-8020

Hudson River Foundation
40 West 20th St., 9th Floor
New York, NY 10011
(212) 924-8290

Hudson River Heritage
Kate Kerin, Executive Director
P.O. Box 287
Rhinebeck, NY 12572
(845) 876-2474

Hudson Valley Green
P.O. Box 208
Red Hook, NY 12571
(845) 758-4484

Hudson Valley Sustainable Communities Network
148 Cottekill Road
Cottekill, NY 12419
(845) 687-0239 or
(845) 687-9253
website: www.hudsonvalley.com/hvscn

***Institute of Ecosystem Studies**
Alan Berkowitz
Director of Education
Box R
Millbrook, NY 12545
(845) 677-5359
website: www.ecostudies.org

***Marist College**
290 North Road
Poughkeepsie, NY 12601
(845) 575-3000
website: www.marist.edu

Mid-Hudson Pattern for Progress
Michael J. DiTullo, President
Desmond Campus
6 Albany Post Road
Newburgh, NY 12550
(845) 565-4900
website: www.pattern-for-progress.org

The Nature Conservancy
Lower Hudson Chapter
Kathleen Moser, Executive Director
19 North Moger
Mt. Kisco, NY 10549
(845) 244-3271
Fax: (845) 244 –3275

***New York City Department of Environmental Protection**
Drinking Water Quality Control
Natural Resources Section
465 Columbus Avenue, Suite 190
Valhalla, NY 10595
(845) 773-4422

New York Natural Heritage Program
700 Troy-Schenectady Road
Latham, NY 12110-2400
(518) 783-3932

New York Public Interest Research Group (NYPIRG)
9 Murray Street
New York, NY 10007-2272
(212) 349-6460

***New York State Department of Environmental Conservation (DEC)**
Nonpoint Source Management Program
50 Wolf Road
Albany, NY 12233
(518) 457-1162
Fax: (518) 457-7744

- **Region 3 Regulatory Affairs**

21 South Putt Corners Road
New Paltz, NY 12561
(845) 255-3121

- **NYS DEC Hudson River National Estuarine Research Reserve**

c/o Bard College Field Station
Annandale, NY 12504
(845) 758-7010
Fax: (845) 758-7033

NYS Department of State (DOS)
Coastal Resources and Waterfront Revitalization Program
Local Waterfront Revitalization Program
41 State St.
Albany, NY 12231
(518) 474-6000

***New York State Department of Transportation**
State Campus, Building 4
Albany, NY 12232
(518) 457-3555

New York State Energy Research and Development Authority (NYSERDA)
Energy Efficient Wastewater Treatment and Sludge Management Technologies
286 Washington Avenue Ext
Albany, NY 12203-6399
(518) 862-1090

New York State Environmental Facilities Corporation (EFC)
Clean Water State Revolving Fund
50 Wolf Road, Room 502
Albany, NY 12205
(518) 457-4100
Fax: (518) 485-8494
website: www.nysefc.org

New York State Office of Parks, Recreation and Historic Preservation - Taconic Region
P.O. Box 308
Staatsburg, NY 12580
(845) 889-4100

***New York State Soil and Water Conservation Committee**
c/o NYS Dept. of Agriculture and Markets
1 Winners Circle
Albany, NY 12235
(518) 457-2713

New York State Water Resources Institute
Rice Hall
Cornell University
Ithaca, NY 14853-5601
(607) 255-5941
Fax: (607) 255-5945

Open Space Institute, Inc.
Rural New York Grant Program
666 Broadway, 9th Floor
New York, NY 10012
(212) 505-7480

Stonykill Environmental Education Center
Route 9D
Wappinger Falls, NY 12590
(845) 831-8780

***Town of Clinton**
P.O. Box 208
Centre Road
Clinton Corners, NY 12514
(845) 266 – 5853

***Town of East Fishkill**
370 Route 376
Hopewell Junction, NY 12533
(845) 221-9191

***Town of Fishkill**
807 Route 52
Fishkill, NY 12524-3110
(845) 831-7800

***Town of Hyde Park**
4383 Albany Post Road
Hyde Park, NY 12538
(845) 229-2103

***Town of LaGrange**
120 Stringham Road
LaGrangeville, NY 12540
(845) 452-1830

***Town of Milan**
Route 199, P.O. Box 42
Red Hook, NY 12571
(845) 758-5133

***Town of Pine Plains**
P.O. Box 320, South Main Street
Pine Plains, NY 12567
(518) 398-7155

***Town of Pleasant Valley**
Route 44
Pleasant Valley, NY 12569
(845) 635-3274

***Town of Poughkeepsie**
1 Overocker Road
Poughkeepsie, NY 12603
(845) 485-3600

***Town of Stanford**
26 Town Hall Road & Route 82
P.O. Box 436
Stanfordville, NY 12581
(845) 868-1366

***Town of Washington**
P.O. Box 667, Reservoir Drive
Millbrook, NY 12545
(845) 677-3419

***Trout Unlimited (Mid-Hudson Chapter)**
187 Church Lane
Stanfordville, NY 12581

U.S. Department of the Interior Fish and Wildlife Service Region 5
3817 Luker Road
Cortland, NY 13045
(607) 753-9334
Fax: (607) 753-9699

U.S. Department of Agriculture

- **Farm Service Agency (FSA)**
  Farm and Home Center, Route 44
  P.O. Box 138, Millbrook NY 12545
  (845) 677-3952

- **Natural Resources Conservation Service (NRCS)**
  Farm and Home Center, Route 44
  P.O. Box 37, Millbrook NY 12545
  (845) 677-3194

U.S. Department of Housing and Urban Development
Community Development Block Grants/
Small Cities Program
26 Federal Plaza
New York, NY 10278-0068
(212) 264-6500
Fax: (212) 264 - 0246

U.S. Environmental Protection Agency (EPA), Region II
290 Broadway
New York, NY 10007
(212) 637-3000

U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
(518) 285-5600

***Village of Millbrook**
Village Hall, Merritt Avenue
Millbrook, NY 12545
(845) 677-3939

***Village of Wappinger Falls**
2 South Avenue
Wappinger Falls, NY 12583
(845) 297-8773

***Wappinger Creek Watershed Planning Committee**
c/o Dutchess County EMC
2715 Route 44, Suite 2
Millbrook, NY 12545
(845) 677-5253

***Wappinger Lake Committee**
7 Spring Street
Wappinger Falls. NY 12583

New York City Department of Environmental Protection: Watershed Planning and Community Affairs
Ashokan Reservoir
Route 28A, P.O. Box 370
Shokan, NY 12481
(845) 657-5772

Youth Resource Development Corp – Americorps
98 Cannon Street
Poughkeepsie, NY 12601
(845) 473-5005

Appendix 5: Wetlands in the Wappinger Creek Watershed

- * indicates that the wetland is not included on 1998 DEC Wetlands map
- Wetlands in bold were marked by participants at the watershed conference

DEC Designation	Class	Location	Size (acres)	Closest Waterway
SP-1	2	Clinton - Schultz Hill Rd	35	Trib. of Little Wappinger
SP-2	2	Clinton - Schoolhouse Rd	30	Trib. of Little Wappinger
SP-3	2	Clinton - Schoolhouse Rd	30	Trib. of Little Wappinger
SP-4	2	Clinton - Fiddler's Bridge	28	Trib. of Little Wappinger
SP-5	2	SW Stanford - Pumpkin La	12.4	Upton Lake Creek
SP-8	2	W Clinton	20	Trib. of Great Spring Creek
SP-9	2	Clinton	57	Little Wappinger Creek
SP-10	2	Clinton - Sunset Trail	24	Trib. of Little Wappinger
SP-11	2	E Clinton - Horseshoe Trail	65	Trib. of Little Wappinger
SP-12	2	E Clinton	24	Trib. of Upton Lake Creek
SP-13	2	SW Stanford - Hobbs La	19	Upton Lake Creek
*SP-14	3	Clinton-S of Hollow Rd	15	
SP-15	2	SW Clinton - Hollow Rd.	18	Trib. of Great Spring Creek
*SP-16		Clinton-N of Hollow Rd, E of Walnut La	13	
SP-17	2	S Clinton - Hollow Rd.	24	Trib. of Wappinger Creek
SP-18	**2**	**S Clinton - Hollow Rd.**	**14**	**Trib. of Wappinger Creek**
SP-23	2	SW Clinton - Sodom Rd.	40	Trib. of Great Spring Creek
SP-24	2	SW Clinton - Browning Rd.	15	Trib. of Great Spring Creek
SP-25	3	SE Clinton - Clinton Corners	15	Upton Lake Creek
SP-27	2	NW Pleasant Valley-Ward Rd.	112	Trib. of Great Spring Creek
*SP-30		N of Victory La	40	
SP-31	2	NW Pleasant Valley-Ring Rd.	21	Trib. of Great Spring Creek
*SP-32		Pleasant Valley-NE of Ring/Marshall intersection	18	
*SP-33		Pleasant Valley-Ward/Robinson	15	
SP-34	2	SW Clinton - Browning Rd	20	Trib. of Great Spring Creek
SP-35	2	NW Pleasant Valley-Quaker La	101	Trib of Great Spring Creek
SP-36	2	NW Pleasant Valley-Crum Elbow Rd	24	Trib. of Great Spring Creek
*SP-37		Pleasant Valley-Ward/Robinson	40	
SP-38 SP-39	2	NW Pleasant Valley-Ring Rd	13 14	Trib. of Great Spring Creek
*SP-51		1/2 mile NW of Taconic/Route 44	14	Trib. of Wappinger Creek
*SP-50		Pleasant Valley-Barkit Kennel Rd	13	Trib. of Wappinger Creek
*SP-55			46	
SP-54	2	E Pleasant Valley-Brown Rd	29+	Trib. of Wappinger Creek
*SP-41			14	
*SP-42			13	
SP-43	2	W Pleasant Valley-Melville Rd	23	Trib. of Great Spring Creek
*SP-44 *SP-45		Pleasant Valley-Near 46, 47, and 48	20	Great Spring Creek
*SP-46 SP-47 SP-48	 2 2	C Pleasant Valley-SP Turnpike	16 29	Great Spring Creek
SP-52	2	SE Hyde Park-Quaker La	21	Trib. of Great Spring Creek
SP-53	2	W Pleasant Valley-Wigsten Rd	32	Great Spring Creek
SP-59	2	SE Clinton	18	Trib. of Wappinger Creek
MB-4	**2**	**S Stanford-Ludlow Rd**	**28**	**Trib. of Wappinger Creek**
MB-10	3	S Stanford-Duell Rd	16	Trib. of Wappinger Creek
MB-11	2	S Stanford-Duell Rd	49	Trib. of Wappinger Creek
MB-15	2	Stanford/Washington-Stanford Rd	24	Trib. of Wappinger Creek
MB-16	3	N Washington-Bangall Rd	17	East Branch

MB-17	2	Stanford/Washington-Ludlow Rd	51	Shaw Brook
MB-18	1	S Stanford-Mabbetsville Rd - Watershed divide	275	Trib. of Wappinger Creek
MB-19	3	S Stanford-Mabbetsville Rd	15	Trib. of Wappinger Creek
MB-21	3	N Washington-Shunpike	12.8	Wappinger Creek
MB-23	3	NW Washington-Stanford Rd	72	Trib. of Wappinger Creek
*MB-24			13	
MB-25	2	N Washington-Valley Farm Rd	40	East Branch Wappinger Creek
MB-26	2	N Washington-Shunpike	36	Shaw Brook
MB-27	2	N Washington-Shunpike	42	Shaw Brook
MB-28	2	N Washington-Shunpike	86	Shaw Brook
*MB-29		Washington-S of Woodstock	21	
*MB-30		Washington-E of Valley Farm Rd	28	East Branch
MB-31	2	N Washington-Bangall Rd	57	East Branch Wappinger Creek
*MB-32			13	
MB-33	2	N Washington-Bangall Rd	31	Shaw Brook
MB-34	2	N Washington-Bangall Rd	200+	Shaw Brook
MB-35	2	NW Washington-Haight Rd	50+	Shaw Brook
*MB-36			50+	
*MB-37		Washington-W of Fowler Rd	144 93	East Branch
*MB-38		Bennett Light?	36	
MB-39	2	Millbrook-Sharon TP	139	Mill Brook
*MB-40		NE of Duell Rd '86 map	53	
*MB-42		NW of Anson Rd '87 map	97	
MB-43		S Stanford-Sisters Hill Rd	22	Trib. of Wappinger Creek
MB-44	1	Millbrook-Sharon TP	14	Mill Brook
MB-45	2	SW Washington-Verbank RD	46+	Trib. of East Branch
MB-9 MB-21 MB-22 MB-65 *MB-54	3	NW Washington-Shunpike	15 14 51	Wappinger Creek
PP-5	**2**	**C Pine Plains-Lake Rd**	**75**	**Wappinger Creek**
PP-8	1	Pine Plains and Stanford	1000	Wappinger Creek
PP-7	2	Milan-Knob Hill Rd	20	Cold Spring Creek
PP-9	3	Pine Plains-Lake Rd		Wappinger Creek
*PP-10			13	
PP-12	**2**	**Pine Plains-Willow Vale Rd**	**38**	**Trib. of Wappinger Creek**
*PP-13			28	
*PP-14			18	
PP-15	2	Milan-S of Knob Hill Rd is in Watershed	71 21,17	Cold Spring Creek
PP-16	2	Pine Plains-S of Briarcliff La	28	Wappinger Creek
*PP-17			20	
*PP-18			13	
*PP-19			25	
PP-20	2	Milan-Cold Spring Rd	18	Cold Spring Creek
*PP-21		Pine Plains-W of Hicks Hill Rd	14	
PP-22	**2**	**SW Pine Plains-Hicks Hill Rd**	**19**	**Trib. of Cold Spring Creek**
PP-23	2	NW Stanford-Cold Spring Rd	17	Cold Spring Creek
*PP-24		Stanford/PP line-Hicks Hill Rd	14	
PP-25	2	N Stanford-Mountain Rd	22	Trib. of Mountain Brook
PP-26	3	N Stanford-Mountain Rd	13	Wappinger Creek
*PP-27		Stanford	17	
PP-30	2	NW Stanford-Wendover Rd	121 ,36 ,30	Trib. of Wappinger Creek
PP-31	2	NW Stanford-Cold Spring Rd	48	Cold Spring Creek
*PP-33	2	W Stanford-Bulls Head Rd	67	
PP-34	2	Stanford-S of Stissing Rd	20	Wappinger Creek
PP-35	2	W Stanford-Bowen Rd	20	Trib. of Wappinger Creek

PP-36	3	W Stanford-Homan Rd	15	Trib. of Wappinger Creek
*PP-37		East of Rte 82	13	
PP-38	2	W Stanford-Bowen Rd	15	Trib. of Wappinger Creek
PP-39	2	NE Stanford-Hunns Lake Rd	13	Hunns Lake Creek
PP-40	2	NE Stanford-Hunns Lake Rd	38	Hunns Lake Creek
PP-41	3	W Stanford-Market La	18	NA
PP-42	2	W Stanford-Bowen Rd	97	Trib of Wappinger Creek
PP-43	3	Stanford-Creamery Rd	17	Trib. of Wappinger Creek
PP-44	3	Stanford-Creamery Rd	13	Trib. of Wappinger Creek
PP-45	3	Stanford-Hunns Lake Rd	20	Hunns Lake Creek
PP-46	2	E Stanford-E of Layton Rd	32	Trib. of Huns Lake Creek
RC-4	**2**	**Milan-Woody Row Rd**		**Little Wappinger Creek**
RC-12	2	Milan-Pond Rd	185	Little Wappinger
***RC-16**		**N of Bulls Head Rd along Wappinger Creek**	**35**	**Wappinger Creek**
*RC-19			37	
RC-20	2	Milan-Field Rd	12.4	Little Wappinger
RC-21	2	Milan-Willowbrook Rd	70	Little Wappinger
RC-22	2	Milan-Taconic	16	Trib. of Cold Spring Creek
RC-26	2	Milan-Lamoree Rd I/2 in Watershed	16	Trib. of Little Wappinger
*RC-27			37	
RC-32	2	Milan-Pond Rd	72	Little Wappinger
*RC-33		Milan	13	
RC-34		NW Stanford-W of Taconic	15	Trib. of Wappinger Creek
RC-39	1	NE Clinton-Silver Lake Rd	124	Little Wappinger
RC-41	2	NE Clinton	56	Trib. of Little Wappinger
RC-42	2	E Clinton-Bull's Head Rd	21	Trib. of Little Wappinger
RC-43	2	NW Stanford-Woods Dr.	38	Trib. of Wappinger Creek
*RC-47			27	
*RC-48			15	
RC-49	2	E Clinton-Nine Partners Rd	20	Trib. of Little Wappinger
RC-52	2	Clinton-Long Pond Rd	117	Little Wappinger
*RC-63		Clinton-Corner of Nine Partners Rd and Pumpkin La	14	
RC-66	2	Clinton-Long Pond Rd	14	Little Wappinger
RC-67	2	Clinton-Pumpkin La	13	Trib. of Little Wappinger
*RC-123			5	Connected to Hudson River Watershed
PV-2	**2**	**SW Pleasant Valley, and NE Poughkeepsie**	**218 170**	**Great Spring Creek**
PV-3	2	SW Pleasant Valley-Pleasant Valley Rd	43	Trib. of Wappinger Creek
PV-4	2	SW Pleasant Valley-Traver Rd	72	Trib. of Wappinger Creek
PV-5	2	S PV-Rossway Rd	47	Trib of Wappinger Creek
PV-6	2	S Pleasant Valley-Taconic Parkway	13	Trib. of Wappinger Creek
*PV-7			46	
*PV-8			12.4	
*PV-9		N Lagrange-N of Rombout Rd	14	
PV-10	1	N Lagrange-Traver Rd	63	Trib. of Wappinger Creek
*PV-11	2	Lagrange-W of Medaugh Rd '85 map	14	
PV-16	1	NW Lagrange-Rombout Rd	13	Trib. of Wappinger Creek
PV-17	1	NW Lagrange-Rombout Rd	23	Trib. of Wappinger Creek
PV-18	3	NW Lagrange-Traver Rd	42	Trib. of Wappinger Creek
PV-21	1	NW Lagrange-Overlook Rd	67	Trib. of Wappinger Creek
*PV-22		Lagrange-W of Freedom Plains Rd	17	
PV-27	2	NW Lagrange-Cramer Rd	13	Trib. of Wappinger Creek
PV-28	3	NW Lagrange-Overlook Rd	36	Trib. of Wappinger Creek
PV-29	3	NW Lagrange-Cramer Rd	80,14,45	Trib. of Wappinger Creek
PV-31	3	W Lagrange-Titusville Rd	15	Wappinger Creek
PV-32	2	W Lagrange-Clover Hill Rd	17	Wappinger Creek

PV-33	2	W Lagrange-Titusville Rd	60	Trib. of Wappinger Creek
*PV-34		Lagrange-S of Todd Hill Rd	19	Trib. of Wappinger Creek
PV-45	2	SW Lagrange-Daley Rd	15	Trib. of Wappinger Creek
*PV-46		Lagrange-W of Maloney Rd '85 map	16	Trib. of Wappinger Creek
PV-51	2	N Wappinger-Maloney Rd	28	Trib. of Wappinger Creek
PV-52	2	S Lagrange-Organ Hill Rd	73	Trib. of Wappinger Creek
*PV-55		N Wappinger-S of Maloney Rd	13	
*PV-56		N Wappinger-W of Smith Crossing Rd 85' map	18	
PV-67	2	N Wappinger-Maloney Rd	13	Trib. of Wappinger Creek
WF-1	**3**	**N Wappinger-Nicholas Rd**	**20**	**Wappinger Creek**
WF-2	3	N Wappinger-Meyers Corners Rd	23	Trib. of Wappinger Creek
WF-3	**3**	**Wappinger-Rte 9 and Meyers Corners**	**15(?)**	**Trib. of Wappinger Creek**
*WF-4		Wappinger-Meyers Corners and Rte 9D	21	
WF-5	2	Wappinger-Spook Hill Rd	45	Trib. of Wappinger Creek
WF-6	2	Wappinger-S of Kent Rd	24	Wappinger Creek
*WF-7		W Wappinger-Old State Rd	16	Trib. of Wappinger Creek
WF-8	3	Wappinger-S of Losee Rd	23	Trib. of Wappinger Creek
WF-10	3	S Wappinger-Old State Rd.	25	Trib. of Wappinger Creek
WF-11	2	S Wappinger-Osbourne Hill Rd	185	Trib. of Wappinger Creek
WF-13	2	S Wappinger-Chelsea Rd	68	Trib. of Wappinger Creek
WF-14	2	S Wappinger-Baxtertown Rd	71	Trib. of Wappinger Creek
*WF-15		Wappinger-N of Baxtertown Rd	34	Trib. of Wappinger Creek
WF-25	3	Wappinger-Kent Rd	56	Trib. of Wappinger Creek
WF-27	3	Wappinger-Meyers Corners Rd	22	Trib. of Wappinger Creek
Wf-28	3	Wappinger-Ketchamtown Rd	24	Trib. of Wappinger Creek
WF-31	1	Wappinger-Route 9	28	Wappinger Creek
HJ-1	3	Wappinger-W of Degarmo Hill Rd	32	Trib. of Wappinger Creek
HJ-2	2	Wappinger-E of Degarmo Hill Rd	16	Trib. of Wappinger Creek
HJ-3	2	Wappinger-Hillside Lake Rd	29	Trib. of Wappinger Creek
HJ-4	2	Wappinger-E of Conrail RR	24	Trib. of Wappinger Creek
HJ-67	2	Wappinger-N of Kent Rd	24	Trib. of Wappinger Creek

ULI Wetlands of less than 12.4 acres in the Wappinger Creek Watershed

DEC Designation	Class	Location	Tax Parcel #	Size (acres)	Nearest Waterway
PP-56		Stanford-S of Homan Rd	6669-00-527298	8.7	Cold Spring Creek
PP-57		Stanford-N of Homan Rd	6669-00-527298	7.8	Trib. of Wappinger Creek
PV-71		Lagrange S of Rombout Rd	6361-02-714883	1.6	Trib. of Wappinger Creek
SP-56		Clinton-N of Willow La	6468-00-950050	11.3	Trib. of Wappinger Creek

Appendix 6: NYSDEC and National Wetland Inventory Wetland Classifications

National Wetland Inventory Classifications:

Table 8. QUICK CROSS REFERENCE OF MAP CODES TO COMMON WETLAND TYPES (Using System, Subsystem and Class)

MAP CODE	COMMON NAME or WETLAND TYPE
PFO	FORESTED OR WOODED SWAMP OR BOG
PSS	SHRUB SWAMP OR BOG
PEM	EMERGENT MARSH, FEN, OR WET MEADOW
PUB	POND
PUS	POND SHORELINE
PAB	POND WITH FLOATING OR SUBMERGED AQUATIC VEGETATION
R1UB	FRESHWATER TIDAL RIVER
R2UB	SLOW MOVING RIVER WITH FLOODPLAIN
R2AB	RIVER WITH AQUATIC VEGETATION (PICKERELWEED)
R3US	BANK OR SHORELINE OF FAST FLOWING RIVER
R4SB	INTERMITTENT STREAM CHANNEL
R5UB	RIVER SHOWING CHARACTERISTICS OF BOTH UPPER AND LOWER PERENNIAL RIVERS
M1UB	OPEN OCEAN WITH UNCONSOLIDATED BOTTOM
M2AB	INTERTIDAL SEAWEED BED IN OCEAN
M2RF	INTERTIDAL OYSTER AND MUSSEL REEFS IN OCEAN
E2EM	SALT OR BRACKISH TIDAL MARSH
E2SS	ESTUARINE SHRUB SWAMP
E2US	ESTUARINE FLATS, BEACH, OR SAND BARS
E1UB	OPEN WATER ESTUARY
L1UB	DEEPWATER ZONE OR LAKE
L2US	LAKE SHORE OR SHALLOW WATER ZONE OF LAKE
L2AB	AQUATIC VEGETATION IN LAKE
L2UB	SHALLOW WATER ZONE OF LAKE

DEC Wetland Classifications:

664.5 Classification System.

Not all wetlands supply equally the benefits explained in section 664.3 (b). The degree to which wetlands supply benefits depends upon many factors, including: their vegetative cover, their ecological associations, their special features, their hydrological and pollution control features, and their distribution and location; and these may vary considerably from wetland to wetland.

Because of this variation, the act requires the commissioner to classify wetlands in a way that recognizes that not all wetlands are of equal value. This section establishes four ranked regulatory classes of wetlands, depending upon the degree of benefits supplied. The benefits cited in section 24-0105 (7) of the act are translated into discernable wetland characteristics, and these characteristics are used to classify wetlands. Section 664.6 describes each characteristic in some detail and discusses the benefits supplied by a wetland when it contains that characteristic.

(a) Class I wetlands.

A wetland shall be a Class I wetland if it has any of the following seven enumerated characteristics:

Ecological associations

(1) it is a classic kettlehole bog (664.6 (b) (2));*

Special features

(2) it is resident habitat of an endangered or threatened animal species (664.6 (c) (2) and (4));

(3) it contains an endangered or threatened plant species (664.6 (c) (4));

(4) it supports an animal species in abundance or diversity unusual for the state or for the major region of the state in which it is found (664.6 (c)(1) and (6));

Hydrological and pollution control features

(5) it is tributary to a body of water which could subject a substantially developed area to significant damage from flooding or from additional flooding should the wetland be modified, filled, or drained (664.6 (d) (1));

(6) it is adjacent or contiguous to a reservoir or other body of water that is used primarily for public water supply, or it is hydraulically connected to an aquifer which is used for public water supply (664.6 (d) (2), (3), and (4)); or

Other

(7) it contains four or more of the enumerated Class II characteristics. This department may, however, determine that some of the characteristics are duplicative of each other, therefore do not indicate enhanced benefits, and so do not warrant Class I classification. Each species to which paragraphs 664.5 (b) (6) through (8) apply shall be considered a separate Class II characteristic for this purpose.

(b) Class II wetlands.

A wetland shall be a Class II wetland if it has any of the following seventeen enumerated characteristics:

Covertype

(1) it is an emergent marsh in which purple loosestrife and/or reed (phragmites) constitutes less than two-thirds of the covertype (664.6 (a) (2));*

Ecological association

(2) it contains two or more wetland structural groups (664.6 (b) (1));

(3) it is contiguous to a tidal wetland (664.6 (b) (3));

(4) it is associated with permanent open water outside the wetland (664.6 (b) (4));

(5) it is adjacent or contiguous to streams classified C(t) or higher under article 15 of the environmental conservation law (664.6 (b) (5));

Special features

(6) it is traditional migration habitat of an endangered or threatened animal species (664.6 (c) (3) and (4));

(7) it is resident habitat of an animal species vulnerable in the state (664.6 (c) (2) and (5));

(8) it contains a plant species vulnerable in the state (664.6 (c) (5));*

(9) it supports an animal species in abundance or diversity unusual for the county in which it is found (664.6 (c) (7));

(10) it has demonstrable archaeological or paleontological significance as a wetland (664.6 (c) (8));

(11) it contains, is part of, owes its existence to, or is ecologically associated with, an unusual geological feature which is an excellent representation of its type (664.6 (c) (9));

664.5 (b)

Hydrological and pollution control features

(12)it is tributary to a body of water which could subject a lightly developed area, an area used for growing crops for harvest, or an area planned for development by a local planning authority, to significant damage from flooding or from additional flooding should the wetland be modified, filled or drained (664.6 (d) (1));

(13) it is hydraulically connected to an aquifer which has been identified by a government agency as a potentially useful water supply (664.6 (d) (4));

(14) it acts in a tertiary treatment capacity for a sewage disposal system (664.6 (d) (3);

Distribution and location

(15) it is within an urbanized area (664.6 (e) (1));

(16) it is one of the three largest wetlands within a city, town, or New York City borough (664.6 (e) (3));*

(17) it is within a publicly owned recreation area (664.6 (e) (4)).

(c) Class III wetlands.

A wetland shall be a Class III wetland if it has any of the following fifteen enumerated characteristics:

Covertypes

(1) it is an emergent marsh in which purple loosestrife and/or reed (phragmites) constitutes two-thirds or more of the covertype (664.6 (a) (2));

(2) it is a deciduous swamp (664.6 (a) (3));

(3) it is a shrub swamp (664.6 (a) (5));

(4) it consists of floating and/or submergent vegetation (664.6 (a) (6));

(5) it consists of wetland open water (664.6 (a) (5));

Ecological associations

(6) it contains an island with an area or height above the wetland adequate to provide one or more of the benefits described in section 664.6 (b) (6);

Special features

(7) it has a total alkalinity of at least 50 parts per million (664.6 (c)(10));

(8) it is adjacent to fertile upland (664.6 (c) (11));*

(9) it is resident habitat of an animal species vulnerable in the major region of the state or in the major region of the state in which it is found, or it is traditional migration habitat of an animal species vulnerable in the state or in the major region of the state in which it is found (664.6 (c) (1), (2), (3), and (5));

(10) it contains a plant species vulnerable in the major region of the state in which it is found (664.6 (c) (1) and (5));

Hydrological and pollution control features

(11) it is part of a surface water system with permanent open water and it receives significant pollution of a type amenable to amelioration by wetlands (664.6 (d) (3));

Distribution and location

(12) it is visible from an interstate highway, a parkway, a designated scenic highway, or a passenger railroad and serves a valuable aesthetic or open space function (664.6 (e) (2));

(13) it is one of the three largest wetlands of the same covertype within a town (664.6 (e) (3));

(14) it is in a town in which wetland acreage is less than one percent of the total acreage (664.6 (e) (3)); or

(15) it is on publicly owned land that is open to the public (664.6 (e) (5)).

(d) Class IV Wetlands

A wetland shall be a Class IV wetland if it does not have any of the characteristics listed as criteria for Class I, II, or III wetlands. Class IV wetlands will include wet meadows (664.6 (a) (1))* and coniferous swamps (664.6 (a) (4)) which lack other characteristics justifying a higher classification.

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* The reference in parentheses after each characteristic is to the description of that characteristic and its associated benefits in section 664.6.

Appendix 7: Best Management Practice Short Descriptions

Agricultural Management Practices

- Access Road Improvement – Structural and vegetative improvements made to farm roadways
- Barnyard Runoff Management System – An installed system for the interception, collection, and safe disposal of runoff water from a barnyard or concentrated livestock area.
- Conservation Tillage – Any tillage and planting system that leaves a minimum of 30% of the soil surface covered with plant residue after the tillage or planting operation. Strip-till, ridge-till and reduced-till are all included under minimum-till definition.
- Constructed Wetlands – A constructed, shallow water area, usually a marsh, dominated by cattail, bulrush, rushes or reeds, designed to simulate the water quality improvement function of natural wetlands. Constructed wetlands are usually a component practice in a total system approach to agricultural wastewater and surface agricultural runoff treatment.
- Contour Farming – The alignment and operation of all farm tillage, planting and harvesting practices as close to the true contour as possible.
- Cover and Green Manure Crop – A crop of close growing grasses, legumes, or small grains grown primarily for temporary, seasonal soil protection and improvement. It is usually grown for 1 year or less. Green manure crops are cover crops, sod crops or intercrops that are plowed under and incorporated into the soil.
- Critical Area Protection: Permanent Vegetative Cover – To establish and/or preserve permanent vegetation on highly erodible areas or land vulnerable to nonpoint source pollution.
- Critical Area Protection: Structural Slope Protection – The stabilization of erosive slopes with riprap, walls or other non-vegetative materials.
- Critical Area Protection: Streambank and Shoreline Protection – The use of vegetation, structures, biotechnology (willow wattles, live cribwalls, brush layering), or management techniques to stabilize and protect streambanks and shorelines.
- Critical Area Protection: Mulching – The application of plant residues or other suitable materials to protect permanent vegetative cover or to stabilize soil independently.
- Critical Area Protection: Temporary Vegetative Cover – Close-growing grasses or legumes established primarily for temporary, seasonal soil protection and improvement.
- Crop Rotation – A planned sequence of annual and/or perennial crops.
- Diversion – An earthen drainageway of parabolic or trapezoidal cross-section with a supporting ridge on the lower side.
- Fencing – To enclose or divide an area of land with a suitable permanent structure that acts as a barrier to livestock.
- Filter Strip – A strip of perennial grasses, legumes or shrubs and trees established or maintained across the slope and managed for pollutant removal by overland flow.
- Grassed Waterway – A natural or constructed channel or parabolic or trapezoidal cross-section that is below ground level and is established in suitable vegetation for the stable conveyance of runoff.
- Integrated Pest Management - An ecologically-based integrated pest control strategy designed to keep pests populations below economically injurious levels using a variety of control tactics, including: biological controls, cultural practices, resistant crop varieties, scouting, and trap crops.
- Irrigation Water Management – A planned system that determines and controls the rate, amount, and timing of irrigation water. May also include "trickle" irrigation systems which deliver water directly to the root zone of plants by means of low volume, low pressure applicators.
- Nutrient Management – An integrated system approach to maximizing the efficient use of plant nutrients. Includes, composting, wise fertilizer management, timed application of manure, analysis of manure nutrients, proper manure storage, and soil testing.
- Nutrient/Sediment Control System – A sequential system of structural and vegetative component practices installed down-gradient from concentrated operations.
- Pasture Management: Short-duration Grazing Systems – A pasture management system using 10 or more paddocks for a grazing season, alternating paddocks every week to allow for forage re-growth.
- Pesticide Management – An integrated systems approach to managing the selection, handling, mixing, use, placement, storage and disposal of pesticides used in agricultural crop production. This may include computerized precision application, evaluation of site specific leaching and surface loss potentials, a permanent structure for pesticide handling, proper equipment calibration, and proper timing and use of pesticides.
- Riparian Forest Buffer – An area of trees, shrubs and grasses located adjacent to and up-gradient from water bodies.

- Stripcropping – Growing annual and perennial crops in a systematic arrangement of strips or bands. When the system is planted on the contour, it is called contour stripcropping. When the system is planted across the general slope, it is called field stripcropping.
- Terraces – An earth embankment, a channel, or a combination ridge and channel constructed across the slope

Construction and Resource Extraction Management Practices

- Administrative Control Mechanisms - Erosion and sediment control ordinances, subdivision rules & regulations, site review, zoning regulations and special easements and covenants. Can be adopted town-wide, countywide, or for special designated areas.
- Check Dam – Small, temporary stone dams constructed across a swale or drainageway.
- Construction Road Stabilization – The temporary stabilization of access routes, on-site vehicle transportation routes, and parking areas on construction sites.
- Construction Waste Management – The proper use or disposal of solid waste materials from construction sites.
- Critical Area Protection (See description under Agricultural Practices)
- Diversions (See description under Agricultural Practices)
- Dust Control – Application of water, construction of wind barriers, or roughening of soil surface to control the movement of airborne pollutants from land-disturbing activities.
- Filter Strip (See description under Agricultural Practices)
- Grade Stabilization Structure – A structure for controlling the grade and gully erosion in natural or artificial channels.
- Grassed Waterway (See description under Agricultural Practices)
- Hazardous Material Management – The proper handling, storage and application of materials defined as hazardous in the Department of Transportation Code of Federal Regulations, Title 49 or in NYS Rules and Regulations, Part 371.
- Level Spreader – A non-erosive outlet constructed to disperse concentrated flows uniformly across a slope.
- Lined Waterway or Outlet – A channel or outlet permanently protected with rock, concrete or other erosion-resistant material for its entire design depth.
- Paved Flume – A small concrete-lined channel used to convey water on a relatively steep slope.
- Pipe Slope Drain – A closed drain installed from the top to the bottom of a slope.
- Planned Land Grading – Reshaping the land surface to planned erosion-resistant grades as determined by engineering survey and layout.
- Riparian Forest Buffer – An area of trees, shrubs and grasses located adjacent to and up-gradient from water bodies.
- Silt Fence – A temporary barrier of geotextile fabric supported by posts and entrenched in the soil.
- Stabilized Construction Entrance – A stable pad of coarse aggregate underlain with filter cloth located at points of construction ingress and egress.
- Staged Land Clearing and Grading – Scheduled or phased land disturbances, each phase being limited to what is required for immediate construction activity.
- Storm Drain Inlet Protection – A sediment barrier installed around a storm drain inlet.
- Straw Bale Dike – A temporary barrier of straw or hay bales which are staked and entrenched in the soil for a depth of at least 4 inches.
- Sub-surface Drain – A conduit installed beneath the ground to collect and/or convey drainage water.
- Sump Pit – A small basin constructed to collect excess water and sediment from excavation.
- Temporary Dike/Swale – A temporary berm and/or excavated channel constructed to direct water to a desired location and stabilized with appropriate materials.
- Temporary Sediment Basin – An earthen basin constructed to intercept sediment-laden runoff and to trap and retain the sediment and water-borne debris.
- Temporary Sediment Trap – A small ponding area constructed to intercept sediment-laden runoff and retain the sediment.
- Temporary Storm Drain Diversion – A re-directed stormwater conveyance which discharges into a sediment trapping device.
- Temporary Watercourse Crossing – A stable structure installed across a watercourse to provide short-term access for construction traffic.
- Topsoiling – Conserving and utilizing a specified quality and quantity of topsoil on disturbed areas.
- Turbidity Curtain – A flexible barrier used to trap sediment in water bodies.
- Waterbar – A ridge, or ridge and channel, constructed across sloping roads, rights-of-way, or other narrow disturbed areas.

Hydrologic and Habitat Modification Management Practices

- Modifying, Operating and Maintaining Flood Control Structures – Design modifications, retrofit modifications, and structural or non-structural practices that can be used in addition to or instead of traditional flood control structures, designs or procedures for their operation or upkeep to improve nonpoint pollution control.
- Modifying, Operating and Maintaining Reservoirs – Operational, vegetative and structural practices that can be used in the maintenance of reservoirs to reduce nonpoint source pollution
- Proper Dam Breaching – The partial or total dismantling of a water impounding structure.
- Streambank and Shoreline Protection:
  - General – The use of vegetation, structures, biotechnology, or management techniques to stabilize and protect streambanks and shorelines.
  - Biotechnical Methods – The use of live dormant stem cuttings or plants in combination with geotextiles or structural devices for erosion control.
  - Selective Clearing and Snagging – Selective removal of trees, log jams, sediments, and other obstructions from the stream channel in order to re-establish the original hydraulic capacity and gradient of the channel.
  - Stream Grade Stabilization Structures – Selective use of instream flow control structures to control scouring and sedimentation in the stream channel due to both natural and human causes.
  - Structural Slope Protection – The stabilization of steep or erosive slopes with riprap, retaining walls, or other non-vegetative materials either, on the streambank or upslope of the stream channel.
- Water Quality and Habitat Protection:
  - Constructed Wetlands (see description in the agricultural section)
  - Improving Instream and Riparian Habitat – Instream and on-bank structures built, or vegetation grown, to improve or create fish habitat in the stream and enhance biodiversity, generally, in the riparian buffer.
  - Restoring Freshwater Wetlands – Reestablishing the functions and character of a wetland that have been degraded or lost by actions such as filling, excavating, draining, altering hydrology, loss of adequate buffer, or introduction of contaminants to return a degraded or former freshwater wetland to a close approximation of a pre-disturbance condition.
  - Restoring Tidal Wetlands – Reestablishing the functions and character of a tidal wetland that have been degraded or lost to a close approximation of a pre-disturbance condition.
  - Riparian Forest Buffer – A corridor of trees, shrubs and grasses of varying width located adjacent to and up-gradient from waterbodies.
  - Stream Corridor Protection Program (Greenbelting) – A program to protect and restore a stream corridor, carried out in cooperation with a unit of government (federal, state or local), the residents of the watershed and other interested conservation organizations.

Leaks, Spills and Accidents Management Practices

- Containing Leaks and Spills
- Controlling Initial Spills (First Response)
- Detecting Leaks and Spills
- Facility Inspection, Facility Maintenance and Personnel Training Programs
- Good Housekeeping Practices
- Inspecting and Maintaining Aboveground Storage Tank Systems
- Materials Compatibility Analysis
- Proper Design of Tanks, Piping Systems and Containment Structures
- Proper Materials Handling and Transfer Operations
- Recordkeeping
- Risk Identification and Assessment (for Chemical Bulk Storage only)
- Security Measures
- Spill Reporting Procedures
- Temporary and Permanent Closure of Storage Facilities
- Testing and Inspecting Underground Storage Tank Systems
- Upgrading Storage Systems

On-site Wastewater Treatment Systems (septic systems) Management Practices

- Site and Soils: Soil and Site Analysis - Identifying crucial soil, water and other land characteristics which determine site suitability for On-site wastewater treatment systems.
- Site and Soils: Percolation Tests - On-site percolation tests for use in design of appropriate On-site wastewater treatment systems.
- Site and Soils: Deep Test Holes - On-site soil profile evaluation for use in design of appropriate On-site wastewater treatment systems.
- Septic Tanks and Standard Absorption Fields (Trenches) - A large (e.g. 1,000 - 1,750 gallon) buried, watertight chamber for settling wastewater with inlet and outlet baffles to prevent discharge of solids, followed by a distribution box that diverts flow equally to two or more perforated pipes laid in gravel trenches within natural, undisturbed soil.
- Aerobic Systems and Standard Absorption Fields - A partitioned watertight compartment with a pump, air compressor or other device to inject air into the sewage in the first compartment. The next component is a settling chamber or filtering device. This is followed by solid piping to a distribution box that distributes effluent to perforated pipes in buried gravel trenches or a gravel bed for infiltration into the soil.
- Other Conventional Systems: Gravelless Absorption Systems - A distribution system installed without gravel-filled trenches, where aggregate is not economically available. It receives effluent from the distribution box in the overall wastewater treatment system. Two types of systems commonly used are: (1) Chamber design (2) Geotextile-wrapped corrugated plastic pipe or tubing.
- Other Conventional Systems: Deep Absorption Trenches - A conventional soil absorption system downstream of a septic or aerobic tank. Used in sites where a thick layer of impermeable soil overlies more suitable soil.
- Other Conventional Systems: Shallow Absorption Trenches - A conventional soil absorption system downgradient of a septic or aerobic tank and having additional soil with a permeability equal to the original underlying soil used for fill.
- Other Conventional Systems: Cut and Fill Systems - A standard absorption trench system installed on sites where impermeable soil overlays a permeable or usable soil.
- Other Conventional Systems: Absorption Bed Systems - Similar to the absorption trench except that several pressure distribution laterals are installed in a single excavation rather than single laterals in several excavations.
- Other Conventional Systems: Seepage Pits - A covered pit with an open-jointed or perforated lining (either concrete or masonry) through which septic tank effluent infiltrates into the surrounding soil. These devices are sometimes called a leaching pit, leaching pool or dry well and are incorrectly called a cesspool. These are generally discouraged by many local regulatory agencies in favor of trench or bed systems.
- Alternative Systems: Raised Systems - A conventional absorption trench systems constructed in stabilized (in place for at least six months and one freeze/thaw cycle) permeable fill placed above the original ground surface on a building lot.
- Alternative Systems: Elevated Sand Mounds - A pressure-dosed absorption system that is elevated above the original soil surface in a sand fill. The system consists of a septic tank (or aerobic tank), dosing chamber and the elevated sand mound.
- Alternative Systems: Intermittent Sand Filters - A biological and physical treatment process consisting of a bed of sand receiving periodic doses of wastewater from the septic tank. The liquid passing through the sand filter is then discharged to a mound absorption system. This practice is called a Buried Sand Filter in some literature.
- Operation and Maintenance for Septic Tanks and Standard Absorption Systems - Tasks that the user or a municipal agent must perform to prevent premature failure of a septic system and to assure the longest possible life span and optimum performance. These include annual inspection, providing new homeowners with a septic system location map, discouraging garbage grinders, avoiding disposal of bulky items in the septic system, discouraging use of septic tank additives, limiting discharges from hot tubs, pool backwash, and whirlpool baths to five gallons per minute, keeping swimming pools and heavy equipment away from leach field, keeping roof and cellar drains away from the system, and practicing water conservation.
- Administration, Operation and Maintenance: Inspection and Pumping - Periodic (e.g. yearly) septic system inspections and routing pumping (every 1 to 5 years, depending on tank size and number of people in household) of the septic tank.
- Administration, Operation and Maintenance: Administrative Control Measures - Regulations, permit processes and other controls available to local units of government for reducing nonpoint source pollution. Examples: Septic surveys, property/home sale contingencies, subdivision rules and regulations, site review and zoning regulations, watershed rules and regulations, wellhead protection measures, and NYS Health Department regulation addendums.
- Conservation Measures: High Efficiency Plumbing Fixtures - Enforcing the use of high efficiency plumbing devices for new systems and promoting their use as a contingency for the approval of a replacement system or upgraded system.
- Conservation Measures: Graywater Separation - Separating toilet water from the wastewater stream and retaining and treating the resulting graywater on-site.
- Public Education: Advocating Proper System Design and Construction - Preventing future on-site wastewater treatment system failure by promoting professional designer, installer and homeowner education on the design and construction of on-site wastewater treatment systems.
- Public Education: Proper Use and Disposal of Household Hazardous Substances - Providing guidelines on the proper use and disposal of household hazardous substances and alternative products that are less hazardous.

- Engineered Systems for Nitrate Removal: Anaerobic Upflow Filters (AUF) - A component of an on-site wastewater treatment system consisting of a 500-2,500 gallon tank (or sand filter underdrain system of equal capacity) containing gravel or rock. The unit is continually submerged in septic tank or sand filter effluent to maintain an anaerobic environment.
- Engineered Systems for Nitrate Removal: RUCK System - A blackwater/graywater separation and treatment system using two septic tanks, a 3-stage sand filter and a standard or custom-designed soil absorption system.
- Engineered Systems for Nitrate Removal: Recirculating Sand Filters - A modified intermittent sand filter in which sand filter effluent is mixed with septic tank effluent and recirculated through the sand filter. A portion of the filtered effluent is discharged to the soil absorption system.
- Engineered Systems for Nitrate Removal: Non-Waterborne Systems - Elimination of toilet (blackwater) waste from the soil absorption system by use of a composting toilet, incinerator toilet, chemical toilet, oil recirculating toilet, pit privy, or pumping to a holding tank.
- Engineered Systems for Nitrate Removal: Constructed Wetlands - An aquatic plant/microbial filter constructed in a gravel bed or gravel trenches. It may be constructed downgradient from the septic or aerobic tank and followed by an absorption field. It may also be constructed downgradient from an elevated sand mound for effluent polishing. It is a component of a complete wastewater treatment system.
- Innovative or Other Systems: Holding Tanks for All Wastewater - Temporary underground storage tanks used to retain all wastewater generated by the household, used only when weather conditions, impending sanitary sewers or other conditions make installation of on-site treatment system impossible or impractical.
- Innovative or Other Systems: Rotating Biological Contactors - A type of aerobic wastewater treatment system where a module rotates through the stored solids which are used as a biological food source, even in no flow or low flow periods.
- Innovative or Other Systems: Trickling Filter-type Systems - A package plant relying on both aerobic and anaerobic bacteria, providing secondary treatment. It receives influent from a septic or aerobic tank and its effluent discharges to a soil absorption system.
- Septic and Aerobic Tanks: Septage Disposal Management - Determining the most practical economic and publicly acceptable means of disposing of the pumped contents of septic tanks, cesspools (no longer allowed for new facilities in New York State) or other individual sewage treatment facilities that receive domestic sewage wastes.

Roadway and Right-of-way Maintenance Management Practices

- Abrasive and Deicing Material Application and Cleanup – Proper calibration of equipment, spreading and clean up of abrasive and deicing material based on the storm conditions to avoid excessive accumulation of the material.
- Catch Basin Cleaning – Cleaning out the catch basins regularly to maintain their sediment trapping ability.
- Control of Bridge Paint Residuals – Methods to avoid the transport to waterbodies of paint chips and dust resulting from surface preparation, grinding, sanding, or washing bridges.
- Deicing Material Mixing and Handling – Taking precautions during mixing and transportation of bulk quantities of deicing chemicals to prevent the transport of salt residue and brine from mixing areas, salt delivery trucks or maintenance vehicles.
- Dust Control – Methods controlling the movement of airborne pollutants and particulate matter from unpaved roads
- Filter Strip - (See description in Agricultural Practices)
- Herbicide Management
    - Proper Equipment Calibrations
    - Proper Timing of Herbicide Application
    - Read and Follow the Label Directions
    - Selective Aerial Application
    - Selective Herbicide Application in Sensitive Areas
- Maintenance of Vegetative Cover – Maintenance and inspection of vegetative cover in critical areas on a regular basis and re-establishment of vegetation in exposed soils.
- Proper Mechanical Control of Vegetation – Proper use of mechanical equipment to remove or reduce undesirable vegetation.
- Proper Road Ditch Maintenance – Techniques for providing stable conditions on the roadside ditches during routine sediment removal, clean up, and ditch reshaping operations.
- Proper Species Selection for Vegetative Cover – Selection of appropriate vegetative species to stabilize the soil and minimize the need for maintenance.
- Restoration of Disturbed Areas Within the Right of Way – Restoration of the disturbed area to its original condition of slope, soil compaction, ground cover, and hydrologic pattern through appropriate practices.
- Salt Storage System:

- Drainage – A system used to temporarily store and properly dispose of salt brine solutions collected at salt loading docks, ramps, or other areas associated with a salt storage system where exposure of salt to precipitation is unavoidable.
- Foundation/Floor – Raising the foundation to an elevation higher than surrounding terrain to prevent run-in; paving the storage area's floor; and providing impermeable padding for the mixing area of the salt storage system.
- Shelter/Cover – The use of a structure, shed, shelter, or impermeable cover to protect the salt from direct precipitation.
- Site Location Selection – Selection of salt storage site location considering the protection of water resources.

- Street Sweeping/Road Cleanup – Use of a mechanical broom sweeper, motorized vacuum sweeper, loaders, or hand tools to clean impervious surfaces

Silviculture Management Practices

- Hazardous Material Management – The proper storage, handling and application of materials defined as hazardous in the Department of Transportation Code of Federal Regulations, Title 49 or in NYS Rules and Regulations, part 371.
- Planned Access Routes – The proper location and design of logging road/skid trail systems.
- Planned Harvest Operations – Harvesting forest products according to a well-developed plan.
- Planned Watercourse Crossings – A stable structure installed across a watercourse to provide temporary access for logging equipment.
- Riparian Buffer Protection – Preservation of natural vegetation and soil cover adjacent to streams or other waterbodies.
- Road Water Management - The control of water on log roads and skid trails.
- Sediment Barriers – Temporary structures installed cross-slope to trap sediment before it reaches watercourses.
- Vegetation Establishment – Seeding grasses and legumes on exposed forest soils.

Urban/stormwater Runoff Management Practices

- Catch Basins – A stormwater runoff inlet equipped with a small sedimentation sump or grit chamber.
- Collection & Treatment of Stormwater – Physical and chemical operations that provide treatment of urban stormwater runoff but are less involved and costly than treatment plant technology and can be either used independently or interfaced with other best management practices.
- Concrete Grid & Modular Pavement – Pavement consisting of strong structural materials having regularly interspersed void areas which are filled with pervious materials, such as sod, gravel, or sand.
- Constructed Wetlands – (See description under Agricultural Practices)
- Critical Area Protection (See description under Agricultural Practices)
- Diversions (See description under Agricultural Practices)
- Dry Detention Basins - A basin designed to collect and store stormwater runoff in a temporary pool of water for less than 24 hours.
- Extended Detention Basin – A basin designed to collect and store stormwater runoff in a temporary pool of water for 24 hours or greater.
- Filter Strip (See description under Agricultural Practices)
- Fluidic Flow Regulators – Self-powered flow control devices operating according to a closed-loop signal system, which is responsive to changes in water level and flow characteristics.
- Grassed Swales – Small vegetated depressions constructed on permeable soils, and designed to convey stormwater runoff from areas less than 1 acre in size.
- Grassed Waterways (See description under Agricultural Practices)
- Implementation of Land Use Planning – Adoption and implementation of comprehensive environmental regulations to govern the development process for the purpose of providing long-term watershed protection.
- Infiltration Basins & Pits – An excavated basin (or pit) constructed in permeable soils, for the temporary collection and storage of urban storm water runoff prior to exfiltration.
- Infiltration Trench – A blind sub-surface trench backfilled with gravel for the temporary collection and storage of storm water runoff prior to exfiltration.
- Integrated Pest Management (see description under Agricultural Practices)
- Irrigation Water Management: (See description under Agricultural Practices)
- Nutrient Management: (See description under Agricultural Practices)
  - Composting Yard and Home Wastes;
  - Fertilizer Management;

- Soil Testing
- Pathogen and Nutrient Management Control:
  - Nuisance Bird Waste Management and Control; Activities undertaken by individuals, corporations and units of government to deter nuisance birds that contribute fecal material to urban stormwater runoff and groundwater.
  - Pet Waste Management and Control; Institutional control measures employed by local governments and management measures employed by individuals to prevent nonpoint source pollution by urban canines and felines.
  - Waterfowl Waste Management and Control; Activities undertaken by individuals, corporations and units of government to deter nuisance waterfowl that contribute fecal material to waterbodies and groundwater.
- Peat/Sand Filter System – Peat/sand filters are gravity driven, constructed filtration systems designed to reduce nonpoint source pollutant loading from urban watersheds to receiving waterbodies.
- Pesticide Management – An integrated systems approach to managing the selection, handling, mixing, use, placement, storage and disposal of pesticides used on turf grasses and ornamental plants in urban areas.
- Porous Pavement – Porous pavement is graded aggregate cemented together by asphalt into a coherent mass that has sufficient interconnected voids to provide a high rate of permeability to water.
- Proper Use and Disposal of Household Hazardous Substances (See description under On-site Wastewater Treatment System Practices)
- Public Education – Nonpoint source instructional programs, workshops and information campaign conducted by educational institutions, agencies and organizations for the public.
- Reduction of Traffic-generated Pollutants – Pollution prevention measures to lower the amount of pollutants originating from motor vehicle traffic in urban areas.
- Retention Pond (Wet Pond) – An excavated pond designed to store and retain a permanent pool of water for evaporation or partial infiltration.
- Riparian Forest Buffer (see description under Hydrologic Modification)
- Roof Runoff System – A system to handle roof runoff by directing it to down spouts and into trenches prior to infiltration into permeable soil.
- Stormwater Conveyance System Storage – Providing storage capability within stormwater conveyance systems for temporary detention and controlled release of urban stormwater during wet weather.
- Stream Corridor Protection Program - (See Greenbelting description under Hydrologic Modification)
- Street and Pavement Sweeping – Use of a mechanical broom sweeper or motorized vacuum sweeper to clean impervious surfaces.
- Urban Forestry (Trees and Shrubs) – Protecting and planting trees and shrubs before, during and after urban site development.
- Water Quality Inlet (Oil/Grit Separators) – Water quality inlets (also known as oil/grit separators) are subsurface, multi-chamber inlets installed in parking lots to trap heavy sediment and hydrocarbons from urban stormwater runoff.

Appendix 8: Land Use Regulation Comparison Chart and Watershed Template Example for the Town of Clinton

Compiled by Jody Match, Land Use Law Center, Pace University School of Law

Note: The complete diagnosis and watershed template for each municipality in the Wappinger Creek Watershed can be obtained from the Dutchess County Environmental Management Council office in Millbrook (914) 677-5253 x 126. Electronic copies of all of the documents are also available.

Wappinger Creek Watershed Analysis Diagnostic System

About The Diagnostic System

The Diagnostic System is designed to digest and analyze local land use regulation. The land Use Law Center has examined voluminous local legislation from municipalities in Westchester, Putnam, Dutchess and Orange counties in developing the Diagnostic System. The result is a checklist and glossary of items that are found often scattered throughout a municipality's land use regulations (i.e. zoning, subdivision and site plan ordinances, wetland regulations, historic preservation ordinances, etc.) The purpose of the Diagnostic System is to create a useable summary of all of the local land use regulations (the "Digest") in a particular municipality and to assist local leaders in analyzing those regulations in different ways. The final result is called the "Digest".

The Watershed Template

The Watershed template is an extended analysis based upon a municipality's land use regulation Digest. It is designed not only to aid each individual municipality, but since a standard format is utilized, it can also be used as a comparison tool for the entire region. The main purpose of the extended analysis is to provide a learning experience for the Land Use Law Center research associate preparing the analysis. It is not meant to offer advice to the community. It allows the associate an opportunity to comment on how the land use regulations of the particular municipality may be protective of a watershed. In that regard, the analysis does not necessarily encompass all regulations that the associate found.

How to use the Watershed Analysis

The Watershed Analysis is also designed to be either a stand-alone document, or to work in conjunction with a municipality's Diagnosis. For that reason, each topic in the Watershed Analysis references the ordinance the information was gathered from, as well as the corresponding page in the diagnosis. However, since the Watershed Analysis is concentrated on one particular issue, certain areas may be discussed more extensively in the Watershed Analysis than in the corresponding Diagnosis section.

The symbol "****" is used to denote a topic for which no information was found by the research associate. It is important to keep in mind that even though the information in the Watershed Analysis may be more extensive than the Digest in regards to watershed protection, it still remains itself a digest of information. Therefore, to find out more information about a particular topic, the municipality's ordinances should be consulted.

Comprehensive Plan

Municipality	**Town of Fishkill**	**Town of Wappinger**	**Village of Wappingers Falls**	**Town of Poughkeepsie**	**Town/Village of LaGrange**
Natural Resource Objectives	• Cluster housing to preserve open space • Protection and preservation of the natural environment • Protection of water related resources, wildlife, steep slopes, hilltops, and valuable wildlife areas though conservation zoning techniques • 4 acre conservation density zoning districts • Protection of aquifers by means of comprehensive groundwater resource protection legislation	• Develop town-wide recycling program • Develop town-wide sewage management and water supply program	• Take full advantage of the unusual recreational opportunities of Wappinger Lake	• Govern development on land with very steep slopes • Protect floodplains from development • Protect wetlands smaller than those protected by the state • Evaluate and protect groundwater resources • Extend existing sewer systems and continue inter-municipal cooperation • Expand and preserve town-wide water system • Obtain buffer lands surrounding Wappingers Creek Watershed and create greenbelt	• Preserve open space through maintenance of parks and recreational lands, nature sanctuaries and greenscape buffer areas • Incorporate planned recreational areas and natural open space in housing developments • Protect wetlands areas • Protect ground and surface water to assure availability of potable water in the future • Minimize environmental impacts of new development
Land Use Objectives	• Wide variety of housing types • Optimum land use and physical amenity • Cluster housing around suburban centers for convenience Preservation of community character	• Preserve stability and character of the community • Locate retail commercial areas close to community centers • Encourage variety of housing types and styles • Development of balanced transportation system	• Encourage diversified growth and maintain single family character of the older village area • Strengthen and restore Main Street area • Encourage development of regionally-oriented business, industry, and apartments in the Route 9 area. • Restore and improve substandard areas	• Provide for compatible land uses • No further strip commercial areas in the town • Development of high quality, landscaped business parks	• Retain rural character • Maintain and enhance amenities of the town • Control quality and type of housing • Control commercial and industrial development • Create a town center • Maintain remaining agricultural uses through incentives and zoning protection
Historic and/or Scenic Objectives	• Develop visually pleasing environment • Encourage high quality aesthetics	****	****	• Require better aesthetic treatment of new development and public spaces	• Maintain visual quality • Preserve historic buildings • Address growing traffic pressure • Establish design criteria

Comprehensive Plan (con'd)

Municipality	Town of Pleasant Valley	Town of Hyde Park	Town of Washington	Village of Millbrook	Town of Clinton
Natural Resource Objectives	• Protection of the watershed by organizing through zoning. • Implementation of an open space plan to protect critical areas and systems • Prepare inventory of natural resources • Encourage clustering • Establish setbacks for protected streams • Limit development in floodplains • Monitor quality of Wappinger Creek • Work regionally to protect Wappinger Creek • Encourage land trusts	• Cluster to preserve open space and provide public facilities • Provide open space for a wide range of uses • Reserve adequate areas for the protection of water related resources, wild life and landforms of environmental value • Preserve areas of ecological importance through zoning techniques • Provide transition areas, buffer spaces, landscaping and natural resource protection	• Protect and enhance beauty of natural environment • Use conservation easements on agriculture land to preserve open space • Preserve steep slopes • Reuse landfill site	• Adopt mandatory clustering to maintain open space, or provide density incentives for clustering • Protect natural drainage network • Upgrade water distribution system • Identify a second source of drinking water • Ensure environmentally sound solid waste disposal system • Delineate aquifer recharge areas • Limit densities in aquifer areas	• Restrict development on steep slopes • Protect till and soil and gravel deposits from contamination to protect ground water • Protect watershed areas, aquifers and wetlands • Land use should be influenced by soil's permeability and depth of bedrock • Protect areas with poor permeability • Use adequate setbacks when siting septic systems • Restrict development on floodplains • Encourage open space
Land Use Objectives	• Use recreation fees collected in subdivision process for improvements and acquisition of new recreational land • Establish trail and public access to Wappinger Creek	• Offer the greatest possible range of opportunities for shelter, services and social needs • Encourage work opportunities close to homes • Encourage compatible land usage • Provide sound support system of utility services	• Preserve rural character • Support the agricultural uses of the community • Develop a variety of affordable and multi-family housing • Promote local oriented businesses • Expand non-conforming commercial uses	• Mandate ¾ or ½ acre lots to preserve rural character in transitional areas • Reduce minimum acreage in PUDs • Allow light industry in business areas • Increase setbacks in residential-mixed use zone • Maintain affordable housing	• Preserve the character of the town and enhance the sense of community • Provide broader range of housing sizes and types • Promote pattern of land use encouraging hamlet areas while maintaining rural character
Historic and/or Scenic Objectives	• Protect watershed by organizing and consolidating existing patterns in the zoning map to advance scenic resource protection. • Prepare inventory of scenic resources	• Encourage preservation of historic buildings and places	• New growth should not disturb historic resources • Preserve historic and visual resources	• Use scenic easements, varied setback requirements, cluster incentives, view protection provisions and architectural review to protect historic and scenic resources	• Identify, protect and restore historic resources • Retain visual resources • Require reclamation of mining sites • Improve transportation system and preserve scenic and historic features

Comprehensive Plan (con'd)

Municipality	Town of Stanford	Town of Milan	Town of Pine Plains
Natural Resource Objectives	• Maintain Agricultural and Open Space Preservation Commission • Protect water quality and supply • Protect wetlands and floodplains • Avoid sprawl • Save trees when developing on steep slopes • No development on slopes > 25% • Preserve aquifer complex by restricting development • Discourage development on unsuitable soils • Use overlays to protect environmentally sensitive areas	****	• Protect the natural environment • Provide for adequate long-term supplies of clean water and the environmentally sound disposal of waste
Land Use Objectives	• Preserve rural character • Maintain agricultural uses • Determine where development should be encouraged • Maintain character of hamlet district • Limit industrial uses to agricultural uses	• Preserve and protect the rural character of the town • Provide options in the quality of housing	• Preserve rural character and beauty of the town • Encourage limited growth • Encourage agricultural uses • Maintain hamlet centers • Provide a range of housing types • Provide alternative transportation • Strictly review new development
Historic and/or Scenic Objectives	• Eliminate impact of sand and gravel mining on the landscape and community character	• Preserve and protect the historical character of the Town	• Encourage high quality aesthetics • Protect historic elements and character

Zoning

Municipality	Town of Fishkill	Town of Wappinger	Village of Wappingers Falls	Town of Poughkeepsie	Town/Village of LaGrange
No. of Districts	15 Districts *p. 4 Diagnosis*	23 Districts *p. 6 Diagnosis*	10 Districts *p. 6 Diagnosis*	17 Districts *p. 4 Diagnosis*	9 Districts *p. 3 Diagnosis*
Overlay Zones	Multifamily Residence District (RMF-5) *p. 16 Diagnosis*	****	****	Office Research Hotel Overlay *p. 6 Diagnosis*	• Stream Corridor Overlay Zone • Farmland Preservation Zone • Historic and Scenic Area Overlay Zone • Ridgeline protection Overlay Zone *p. 11 Diagnosis*
Advisory Boards	• Town Conservation Board • Town Conservation Advisory Council *p. 37 Diagnosis*	****	• Architectural Review Board • Historic Preservation Commission *p. 28 Diagnosis*	Historic Preservation Commission *p. 19 Diagnosis*	****
Enforcement	• Zoning administrator • Building permits • Certificates of occupancy • Penalties for offense *p. 38 Diagnosis*	• Zoning administrator • Building permits • Certificates of occupancy • Penalties for offenses • Schedule of fees *p. 31 Diagnosis*	• Zoning administrator • Building permits • Certificates of occupancy • Penalties for offenses • Schedule of fees *p. 29 Diagnosis*	• Zoning administrator • Building permits • Certificates of occupancy • Penalties for offenses • Schedule of fees *p. 19 Diagnosis*	• Zoning administrator • Building permits • Certificates of occupancy • Penalties for offences • Schedule of fees *p. 31 Diagnosis*

Zoning (con'd)

Municipality	Town of Pleasant Valley	Town of Hyde Park	Town of Washington	Village of Millbrook	Town of Clinton
No. of Districts	12 Districts *p. 6 Diagnosis*	17 Districts *p. 3 Diagnosis*	14 Districts *p. 8 Diagnosis*	8 Districts *p. 3 Diagnosis*	9 Districts *p. 3 Diagnosis*
Overlay Zones	****	Land Conservation District *p. 17 Diagnosis*	• Aquifer Protection Overlay District • Agricultural Protection Overlay District *p. 16 Diagnosis*	****	****
Advisory Boards	Conservation Advisory Council *p. 36 Diagnosis*	Conservation Advisory Council *p. 33 Diagnosis*	• Conservation and Advisory Council • Conservation Board *p. 36 Diagnosis*	****	Conservation Advisory Council *p. 32 Diagnosis*
Enforcement	• Zoning administrator • Building permits • Certificates of occupancy • Penalties for offenses • Schedule of fees *p. 38 Diagnosis*	• Zoning administrator • Building permits • Certificates of occupancy • Penalties for offenses • Schedule of fees *p. 34 Diagnosis*	• Zoning Administrator • Fees • Building permits • Certificates of occupancy *p. 38 Diagnosis*	• Zoning Officer • Building permits • Certificates of Occupancy • Penalties for offenses • Schedule of fees *p. 32 Diagnosis*	• Zoning administrator • Building permits • Certificates of occupancy *p. 33 Diagnosis*

Zoning (con'd)

Municipality	Town of Stanford	Town of Milan	Town of Pine Plains
No. of Districts	5 Districts *p. 6 Diagnosis*	7 Districts *p. 3 Diagnosis*	****
Overlay Zones	****	****	****
Advisory Boards	Conservation Advisory Council *p. 41 Diagnosis*	****	****
Enforcement	• Zoning administrator • Building permits • Certificates of occupancy • Penalties for offences *p. 42 Diagnosis*	• Zoning Officer and building inspector • Building permits • Certificates of occupancy • Penalties for offenses • Schedule of fees *p. 28 Diagnosis*	• Building permits • Certificate of occupancy • Penalties for offenses • Schedule of fees *p. 18 Diagnosis*

Supplemental Regulations

Municipality	Town of Fishkill	Town of Wappinger	Village of Wappingers Falls	Town of Poughkeepsie	Town/Village of LaGrange
Agricultural Land Protection	****	****	****	Agriculture excluding farm animals and including farm animals *p. 6 Diagnosis*	Farmland Preservation Overlay Zone *p. 11 Diagnosis*
Cell Towers	Moratorium on approval, construction and enlargement to develop comprehensive land use regulations regarding cell towers *p. 18 Diagnosis*	Allowed as per restrictions *p. 17 Diagnosis*	• Required setback and screening • Site plan approval required Purpose: to minimize adverse impacts on residential neighborhoods and structures *p. 18 Diagnosis*	Minimum 4 acre zoning by special permit with setback requirements *p. 6 Diagnosis*	• Purpose: to protect the aesthetics of the town, and the health and safely of residents • Must comply with SEQRA and special permit requirements • Bulk requirements *p. 13 Diagnosis*
Clearing Filling and Grading	****	****	Parking facilities must be graded to avoid nuisances of dust, erosion or excessive water flow *p. 18 Diagnosis*	Purpose: to protect public health, safely and welfare by regulating land contour changes *p. 6 Diagnosis*	****
Excavation and Mining	Special use permit required *p. 19 Diagnosis*	****	• Subject to special permit approval • Prohibited if adversely affects natural drainage or the structural safety of adjoining structures or causes nuisance • Must be screened *p. 19 Diagnosis*	Purpose: to protect public health, safely and welfare by regulating land contour changes *p. 7 Diagnosis*	• Floating zone approval at discretion of Town Board • Must obtain “Mining Activity Land Reclamation” approvals *p. 13 Diagnosis*
Landfill and Solid Waste	****	****	Prohibited hazardous materials and uses *p. 19 Diagnosis`*	****	• Must be screened from street/adjoining property • Must comply with Dutchess County Health Department *p. 15 Diagnosis*
PUDs	****	Regulated by special permit requirements as per Town Board *p. 18 Diagnosis*	****	Encourages development of well-designed business parks *p. 7 Diagnosis*	Established pursuant to Town Board requirements *p. 16 Diagnosis*
Uniformity of Design	****	Purpose: to facilitate a stable community and valued real property *p. 18 Diagnosis*	****	Architectural Review *p. 7 Diagnosis*	PDD – intended to have harmonious design with character of town and comprehensive plan *p. 17 Diagnosis*

Supplemental Regulations (con'd)

Municipality	Town of Pleasant Valley	Town of Hyde Park	Town of Washington	Village of Millbrook	Town of Clinton
Agricultural Land Protection	****	****	****	****	Conservation Agricultural Residential District *p. 10 Diagnosis*
Cell Towers	May exceed maximum height requirements *p. 20 Diagnosis*	****	• Communication needs of residents/business will be met while protecting the citizens • Personal wireless radio telecommunication facilities = as of right *p. 18 Diagnosis*	• One per lot • Must be designed to minimize visual impact on adjacent property and roadway *p. 12 Diagnosis*	• Communications antenna or tower • Satellite dish antenna *p. 11 Diagnosis*
Clearing Filling and Grading	• Must clear all brush from streets to maintain an acceptable sight distance • Topsoil removal • Embankment and excavation slopes • Roadway grading *p. 20 Diagnosis*	****	****	****	Off-street parking and loading regulations *p. 11 Diagnosis*
Excavation and Mining	• Quarrying permitted only in Quarry district • Commercial extraction requires special permit as issued by Board of Appeals *p. 21 Diagnosis*	• Policy: to promote preservation and safeguard the natural topography of the land • Permit procedure • Bond required *p. 18 Diagnosis*	Quarrying and soil mining location *p. 19 Diagnosis*	****	• Permitted in the Office-Light Industry District • Permits issued for one year *p. 12 Diagnosis*
Landfill and Solid Waste	• Salvage reclamation operations generally prohibited • Disposal from outside the town generally prohibited *p. 22 Diagnosis*	• Junkyards • Required license • Penalties *p. 20 Diagnosis*	****	Sewerage Facilities *p. 16 Diagnosis*	No private facility allowed *p. 13 Diagnosis*
PUDs	****	****	****	****	Purpose: to encourage flexibility in the design and development of land in order to preserve resources *p. 14 Diagnosis*
Uniformity of Design	****	Frontage uniformity *p. 21 Diagnosis*	****	To promote attractiveness and economic well being of the village *p. 17 Diagnosis*	****

Supplemental Regulations (con'd)

Municipality	Town of Stanford	Town of Milan	Town of Pine Plains
Agricultural Land Protection	****	****	****
Cell Towers	Permissible for nonprofit, noncommercial purposes pursuant to setbacks and screening *p. 14 Diagnosis*	****	****
Clearing Filling and Grading	****	See excavation and mining *p. 8 Diagnosis*	No alteration of watercourses that affects water levels or flow without complete review of the resources by the planning board, Soil Conservation Service, and DEC *p. 2 Diagnosis*
Excavation and Mining	Only permitted in Agricultural Residential District *p. 14 Diagnosis*	Intended to limit environmental damage, soil erosion and sedimentation, disruption of aquifers and other water sources, alteration of natural vegetation, topography and habitats, potential slope instability, landslides and slumping *p. 9 Diagnosis*	• Shall not adversely affect adjoining property • See also: Clearing, Filling and Grading *p. 5 Diagnosis*
Landfill and Solid Waste	• Permitted and prohibited dumping • Prohibition on burning *p. 15 Diagnosis*	No dump permitted *p. 12 Diagnosis*	• Screening • Setbacks • No disposal of certain hazardous wastes • No dumping on steep slopes *p. 5 Diagnosis*
PUDs	****	****	****
Uniformity of Design	****	****	****

Subdivision

Municipality	Town of Fishkill	Town of Wappinger	Village of Wappingers Falls	Town of Poughkeepsie	Town/Village of LaGrange
Separate from Zoning?	Yes	Yes	****	Yes	Yes
Cluster Developments	****	****	****	****	Both a normal subdivision and modified cluster plan must be submitted *p. 28 Diagnosis*
Parks , Open Spaces and Natural Features	Existing natural features shall be preserved, board can require land to be reserved for parks and recreational purposes	Preservation of existing natural features through harmonious design, no unnecessary removal of trees, topsoil or excavated materials. *p. 28 Diagnosis*	****	****	See Public Streets and Recreation *p. 29 Diagnosis*
Public Streets and Recreation	When applicant does not dedicate streets/parks to public, shall submit documents providing for the suitable maintenance of streets and parks *p. 31 Diagnosis*	****	****	Location and specifications of streets, recreational areas, alleys, easements, blocks, lots, future public places and open spaces, grading and drainage *p. 18 Diagnosis*	5-10% of subdivision must be set aside for park or playgrounds *p. 28 Diagnosis*
Application Requirements	Sketch plan, preliminary plat approval, final plat approval. *p. 29 Diagnosis*	Initial consideration/sketch plan, preliminary plat approval, construction plan, final plat approval *p. 27 Diagnosis*	****	Sketch plan, preliminary layout, final plat *p. 16 Diagnosis*	Sketch plan, preliminary plat approval, final plat approval *p. 26 Diagnosis*
Special Considerations	****	****	****	****	****

Subdivision (con'd)

Municipality	Town of Pleasant Valley	Town of Hyde Park	Town of Washington	Village of Millbrook	Town of Clinton
Separate from Zoning?	Yes	Yes	Yes	Yes	?
Cluster Developments	Planning board must encourage flexibility in design and development, promote appropriate use of land, and preserve natural/scenic qualities of residential lots. *p. 33 Diagnosis*	Purpose: to preserve open space, and enhance appearance, character, or natural beauty of an area *p. 28 Diagnosis*	Planning Board authorized to require clustering to preserve open space *p. 30 Diagnosis*	Permitted in all residential districts, purpose is to preserve open space, natural, scenic and historic resources. *p. 27 Diagnosis*	Planned development *p. 27 Diagnosis*
Parks , Open Spaces and Natural Features	Not more than 10%, but shall be reasonable for the neighborhood. *p. 29 Diagnosis*	****	Open space subdivisions, cluster subdivisions, conservation density subdivisions, permanent open space *p. 32 Diagnosis*	About 10% of subdivision should be reserved for parks, playgrounds and other recreational purposes *p. 29 Diagnosis*	May require up to 10% of gross area of subdivision *p. 28 Diagnosis*
Public Streets and Recreation	****	****	Planning Board can require adequate portions of the subdivision. *p. 30 Diagnosis*	****	Approval of final plat is not acceptance of any street, park, playground. Easement may be required for pedestrian access *p. 27 Diagnosis*
Application Requirements	Sketch plan, preliminary plat approval, final plat approval *p. 31 Diagnosis*	Sketch plan, preliminary plat approval, final plat approval *p. 27 Diagnosis*	Sketch plan, preliminary plat approval, final plat approval *p. 29 Diagnosis*	Sketch plan, preliminary plat approval, final plat approval *p. 25 Diagnosis*	Sketch plan, preliminary plat approval, final plat approval *p. 25 Diagnosis*
Special Considerations	****	****	****	****	****

Subdivision (con'd)

Municipality	Town of Stanford	Town of Milan	Town of Pine Plains
Separate from Zoning?	Yes	Yes	Yes
Cluster Developments	Subdivider may request in order to preserve open space and create a perpetual conservation easement on the land. *p. 34 Diagnosis*	In planning board discretion. Open spaces to be used as parks, recreation or other municipal use. *p. 23 Diagnosis*	****
Parks , Open Spaces and Natural Features	10% total land required to be set aside for parks and common open space purposes *p. 37 Diagnosis*	No more than 10% gross area, unusable areas or environmentally constrained areas will be given special consideration *p. 24 Diagnosis*	Important natural features shall be preserved by the way of harmonious design of subdivisions. No more than 10% of gross area set aside *p. 17 Diagnosis*
Public Streets and Recreation	****	****	Regulations include: general requirements, highway classification, and improvements *p. 15 Diagnosis*
Application Requirements	Sketch plan, preliminary plat approval, final plat approval *p. 29 Diagnosis*	Sketch plan, preliminary plat approval, final plat approval *p. 20 Diagnosis*	Sketch plan, preliminary plat approval, final plat approval *p. 14 Diagnosis*
Special Considerations	****	****	****

Site Plan

Municipality	Town of Fishkill	Town of Wappinger	Village of Wappingers Falls	Town of Poughkeepsie	Town/Village of LaGrange
Review Criteria	Consider the requirements of the comprehensive plan and official map. *p. 28 Diagnosis*	Board makes decision based on hearing, application and SEQRA *p. 22 Diagnosis*	Location, height an bulk of buildings, proposed traffic circulation and off-street parking, buffer areas, recreation areas, natural features and other open spaces	Harmonious relationships between existing and proposed development, no adverse neighborhood effects, traffic considerations, aesthetic qualities *p. 13 Diagnosis*	Harmonious relationship with community, no adverse affect on neighborhood, consistency with comprehensive plan, awareness and sensitivity to views, terrain, soils, plant life and other unique qualities of the site. *p. 25 Diagnosis*
SEQRA Coordination	****	SEQRA results to be submitted prior to planning board approval *p. 22 Diagnosis*	****	Applicant responsible for costs incurred during SEQRA process *p. 15 Diagnosis*	Application not complete without compliance with SEQRA *p. 25 Diagnosis*
Required Information	Location information, proposed development, topography, location of parking, outdoor storage, and proposed improvements, location and size of all signs, location of existing vegetation and proposed landscaping, performance bond. *p. 27 Diagnosis*	Maps; existing and proposed roads, railroads, streams, right-of-ways and easements, public facilities, any information pertaining to the land. *p. 22 Diagnosis*	Location information, topography, proposed building information, uses proposed *p. 25 Diagnosis*	Map, building information, topography, proposed grade, road information, location of proposed improvements, landscaping and buffer screens, waste handling facilities *p. 13 Diagnosis*	Location information, proposed development, sewage disposal, topography and grade elevations, location of water supply, location of waste facilities, provisions for handling storm water runoff *p. 24 Diagnosis*

Site Plan (con'd)

Municipality	Town of Pleasant Valley	Town of Hyde Park	Town of Washington	Village of Millbrook	Town of Clinton
Review Criteria	Location, relation to other buildings, traffic, height and bulk, parking, buffer areas and open space, compatibility, drainage, impact on wetlands *p. 29 Diagnosis*	*p. 25 Diagnosis*	Conformity, landscaping, pedestrian and vehicular access, drainage and surface waters *p. 27 Diagnosis*	Harmonious relationships, no adverse effect, relation to comprehensive plan, take advantage of solar access in shading and windscreen potential of existing and proposed vegetation, reflect awareness of and sensitivity to views, terrain, soils, plant life and other unique qualities *p. 24 Diagnosis*	Relationship of all buildings, impact of project on area, compatibility, mini mal degradation of unique or irreplaceable land times, conformity with geological and topographic features, adequate drainage *p. 23 Diagnosis*
SEQRA Coordination	****	No application is complete without SEQRA compliance *p. 25 Diagnosis*	****	No application complete without SEQRA compliance *p. 24 Diagnosis*	Required *p. 23 Diagnosis*
Required Information	Location information, schools, zoning boundaries, public streets, vehicular access, location of water lines, proposed stormwater drainage *p. 29 Diagnosis*	*p. 25 Diagnosis*	Location information, location of utilities, plans to prevent pollution of surface or ground water, erosion of soil, excessive runoff, excessive raising of the water table, and flooding, natural land features, trees greater than 8" in diameter *p. 26 Diagnosis*	Location information, topography, soil types, wetlands, floodplains, steep slopes (10%), landscaping and grading plans *p. 24 Diagnosis*	SEQRA information, map, development information *p. 22 Diagnosis*

Site Plan (con'd)

Municipality	Town of Pleasant Valley	Town of Hyde Park	Town of Washington	Village of Millbrook	Town of Clinton
Review Criteria	Location, relation to other buildings, traffic, height and bulk, parking, buffer areas and open space, compatibility, drainage, impact on wetlands *p. 29 Diagnosis*	*p. 25 Diagnosis*	Conformity, landscaping, pedestrian and vehicular access, drainage and surface waters *p. 27 Diagnosis*	Harmonious relationships, no adverse effect, relation to comprehensive plan, take advantage of solar access in shading and windscreen potential of existing and proposed vegetation, reflect awareness of and sensitivity to views, terrain, soils, plant life and other unique qualities *p. 24 Diagnosis*	Relationship of all buildings, impact of project on area, compatibility, mini mal degradation of unique or irreplaceable land times, conformity with geological and topographic features, adequate drainage *p. 23 Diagnosis*
SEQRA Coordination	****	No application is complete without SEQRA compliance *p. 25 Diagnosis*	****	No application complete without SEQRA compliance *p. 24 Diagnosis*	Required *p. 23 Diagnosis*
Required Information	Location information, schools, zoning boundaries, public streets, vehicular access, location of water lines, proposed stormwater drainage *p. 29 Diagnosis*	*p. 25 Diagnosis*	Location information, location of utilities, plans to prevent pollution of surface or ground water, erosion of soil, excessive runoff, excessive raising of the water table, and flooding, natural land features, trees greater than 8" in diameter *p. 26 Diagnosis*	Location information, topography, soil types, wetlands, floodplains, steep slopes (10%), landscaping and grading plans *p. 24 Diagnosis*	SEQRA information, map, development information *p. 22 Diagnosis*

Resource Protection

Municipality	Town of Fishkill	Town of Wappinger	Village of Wappingers Falls	Town of Poughkeepsie	Town/Village of LaGrange
Erosion and Sediment Control	****	****	****	Regulations set forth the permit procedures, the activities for which a permit is required, and exempted activities *p. 8 Diagnosis*	Provisions for soil erosion and sediment control when performing site alterations, erosion and sediment control plans *p. 18 Diagnosis*
Floodplains	Regulations relate to establishing areas of special flood hazards, penalties, permit applications, powers and duties of the local administrator, the applications and conditions of variances *p. 23 Diagnosis*	Protection provisions establish and permit limited development in floodplain areas *p. 19 Diagnosis*	****	Regulations relate to establishing areas of special flood hazards, penalties, permit applications powers and duties of the local administrator, the applications and conditions for variances *p. 8 Diagnosis*	Regulations relate to establishing areas of special flood hazards, penalties, permit applications, powers and duties of the local administrator, the applications and conditions for variances. *p. 17 Diagnosis*
Steep Slopes	(slopes > 15%) Development on hilltops, ridgelines and steep slopes should be avoided to prevent erosion, minimize stormwater runoff and flooding, and preserve groundwater *p. 24 Diagnosis*	Development on hilltops, ridgelines and steep slopes should be avoided to prevent erosion, minimize stormwater runoff and flooding, and preserve groundwater *p. 19 Diagnosis*	****	****	Overlay zone created to protect steep slopes *p. 18 Diagnosis*
Tree Preservation	Regulates removal of trees to protect/preserve environment and provide soil erosion control *p. 24 Diagnosis*	****	****	****	Trees protected throughout various ordinances (wetland protection, subdivision, landscaping) *p. 19 Diagnosis*
Wetlands	No alteration or development within a wetland without approval *p. 24 Diagnosis*	No alteration or development within a wetland without approval *p. 19 Diagnosis*	****	Regulatory authority undertaken pursuant to state law, regulates wetlands and lands within 100' buffer *p. 10 Diagnosis*	Stream Cooridor Overlay established, list of activities in wetlands requiring a permit set forth and permitting procedures *p. 19 Diagnosis*
Historic Preservation	****	****	***	Protects historic assets, sets up Historic Preservation Commission *p. 11 Diagnosis*	Historic preservation overlay district established *p. 20 Diagnosis*
Viewshed Protection	Regulations include provisions for: fences and walls, landscaping, and signs *p. 25 Diagnosis*	Regulations include provisions for signs *p. 19 Diagnosis*	Regulations include provisions for: fences and walls, landscaping, and signs	Regulations include provisions for: fences and walls, landscaping, and signs *p. 18 Diagnosis*	Regulations include provisions for: fences and walls, landscaping, and signs *p. 20 Diagnosis*

Resource Protection (con'd)

Municipality	Town of Pleasant Valley	Town of Hyde Park	Town of Washington	Village of Millbrook	Town of Clinton
Erosion and Sediment Control	Any activity within the watershed area of the wetlands that would in any manner whatsoever cause erosion and movement of soil or sediment into any wetland *p. 24 Diagnosis*	Regulations minimize erosion and stormwater runoff in multi-family and non-residential developments *p. 22 Diagnosis*	Reduce the volume of sediment entering waterbodies and wetlands by requiring erosion and sediment control plans *p. 22 Diagnosis*	****	Unlawful to do site alteration and construction activities without soil erosion and sedimentation control measures *p. 17 Diagnosis*
Floodplains	Regulations relate to establishing areas of special flood hazards, penalties, permit applications, powers and duties of the local administrator, the applications and conditions of variances *p. 23 Diagnosis*	Regulations relate to construction, variances, and other general standards for development in floodplains *p. 22 Diagnosis*	****	Regualtion activities that increase the risk of flooding *p. 17 Diagnosis*	Impact of development on floodplains must be minimized *p. 17 Diagnosis*
Steep Slopes	Steep topography and rocky land should not be used intensely *p. 24 Diagnosis*	****	****	Regulations state that steep slopes should be preserved *p. 18 Diagonosis*	(Slopes > 15%) Regulates development that may have a negative impact on steep slopes *p. 17 Diagnosis*
Tree Preservation	Large trees shall be preserved insofar as possible *p. 24 Diagnosis*	Shade tree commission established	****	Planting of shade trees required for subdivision approval *p. 18 Diagnosis*	****
Wetlands	No alteration or development within a wetland without approval *p. 25 Diagnosis*	Regulatory authority undertaken pursuant to state law, regulated activities in wetlands *p. 22 Diagnosis*	Permit conditions are imposed for any alteration to a wetland or watercourse or to any activity that impinges upon or substantially affects the wetland or watercourse (exceptions set forth) *p. 22 Diagnosis*	****	Regulates activities that have negative impacts on wetlands, sets forth excepted activites *p. 18 Diagnosis*
Historic Preservation	Sets forth provisions for historic districts and landmark preservation *p. 26 Diagnosis*	****	***	Historic preservation provisions and historic districts set forth *p. 19 Diagnosis*	Provisions protect historic assests *p. 19 Diagnosis*
Viewshed Protection	Regulations include provisions for: fences and walls, landscaping, and signs *p. 26 Diagnosis*	Regulations include provisions for: fences and walls, landscaping, and signs *p. 22 Diagnosis*	Regulations include provisions for: landscaping, and signs p. -- Diagnosis	Regulations include provisions for: landscaping, and signs *p. 19 Diagnosis*	Regulations include provisions for: landscaping, and signs *p. 19 Diagnosis*

Resource Protection (cont'd)

Municipality	**Town of Stanford**	**Town of Milan**	**Town of Pine Plains**
Erosion and Sediment Control	Sediment Control measures must be present in all construction plans *p. 15 Diagnosis*	****	Adequate erosion control shall be undertaken during development, development in areas subject to erosion should be minimized *p. 6 Diagnosis*
Floodplains	Protects designated floodplain areas. Prohibits development in floodways *p. 15 Diagnosis*	Regulations relate to establishing areas of special flood hazards, penalties, permit applications, powers and duties of the local administrator, the applications and conditions for variances *p. 13 Diagnosis*	Development in 100 year floodplain should be avoided, any obstruction of floodways is prohibited *p. 6 Diagnosis*
Steep Slopes	****	****	(Slopes > 15%) Development on steep slopes shall be minimized *p. 7 Diagnosis*
Tree Preservation	Logging permit required for any logging or timber harvesting p. 16 Diagnosis	****	No alteration shall be made that affects the water levels or flow of watercourses without review as to the effect on water recharge areas, water table levels, water pollution, aquatic animal and plant life, temperature change, drainage, flooding, runoff and erosion *p. 8 Diagnosis*
Wetlands	Regulatory authority undertaken pursuant to state law, regulates wetlands and lands within 100' buffer *p. 25 Diagnosis*	****	No alteration shall be made that affects the water levels or flow of watercourses without review as to the effect on water recharge areas, water table levels, water pollution, aquatic animal and plant life, temperature change, drainage, flooding, runoff and erosion *p. 8 Diagnosis*
Historic Preservation	****	****	Historic assets shall be preserved through harmonious design of the subdivision *p. 9 Diagnosis*
Viewshed Protection	Regulations include provisions for signs *p. 19 Diagnosis*	Regulations include provisions for signs *p. 16 Diagnosis*	Regulations include provisions for: landscaping, and signs p. 9 Diagnosis

Extended Analysis

> This analysis is primarily a learning exercise for the Land Use Law Center research associate at the Pace University School of Law, and it is not meant to offer advice to the community. It allows the associate an opportunity to comment on how the land use regulations of the particular municipality may be protective of a watershed. In that regard, this analysis does not necessarily encompass all regulations a municipality may have that are protective of the watershed, only those that fall within land use regulations that the asscociate found.

Watershed Analysis for the Town of Clinton

General Protection Provisions
(Note: List only the purposes and goals that affect watershed protection)
Discharge and Storage

A. **Comprehensive Plan- Diagnosis p. 39; Comprehensive Plan**

1. Discourage the development and encourage protection of 100-year floodplains, wetlands, surface waters, slopes over 15% and ridgelines to ensure minimal disruption of their environmental function and scenic qualities
2. Provide for densities which are compatible with the soils' ability to support development, while protecting prime and important agricultural soils
3. Promote a land use pattern that protects surface and groundwater resources and work to eliminate or minimize all known sources of pollution, such as road salt, leaching dump sites, and the use of herbicides on utility cooridors
4. Strictly control development in prime aquifer recharge areas to prevent overuse or contamination of groundwater
5. Protect prime and statewide important agricultural soils
6. Identify and protect important wildlife habitats
7. Require measures to control erosion and sedimentation
8. Require the complete reclamation of mining sites and minimize the environmental and aesthetic damage called by extractive operations

9. Define an open space system to protect natural cooridors, particular along streambeds and wetlands, wildlife habitat, and groundwater.

10. Encourage reduced assessments, development plan trade-offs, government purchase of development rights, and other similar approaches.

B. Site Plan Regulations Diagnosis p. 22 ; Zoning § 7.9

The site plan process is intended to:

a) Illustrate the intended design, arrangement, and uses of the land to be improved

b) Describe the proposal's physical, social, and economic effects on the community

C. **Subdivision Regulations**- Diagnosis p. 24 ; Zoning § 11

1. Land shall be subdivided to protect from the peril of flood

2. Proper provision shall be made for drainage, water supply, sewerage, and other needed improvements and facilities

D. **Zoning-** – Diagnosis p. 3 ; Zoning § 1.2

1. Prevent the pollution of streams, ponds, and all other water resources, and to encourage the wise use and sound management of natural resources throughout the town

2. Facilitate the provision of water supply, sewage disposal, and other public facilities

3. To protect and promote the continuation of agriculture as an economic activity, a land use, and a method of maintaining open space

E. **Special Permits- ****

F. **Cluster Provisions**- Diagnosis p. 14; Zoning § 5.16

II. Discharge and Storage

A. **Discharge or storage of pathogenic materials** – (Not found in Diagnosis p. __ ; Zoning § 5.2

1. Prohibitions

No emission of toxic or noxious fumes is permitted

2. **Restrictions**

****

3. **Exceptions and/or Exemptions**

****

B. Discharge or storage of hazardous substances and hazardous wastes – Not found in Diagnosis; Zoning § 5.2

1. **Prohibitions**
   No emission of toxic or noxious fumes is permitted

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

C. New storage facilities or new tanks at an existing facility

1. **Prohibitions**
   ****

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

4. **Limiting Distance**

   ****

D. Discharge or storage of radioactive materials – Not found in Diagnosis ; Zoning § 5.2

1. **Prohibitions**
   No emission of radiation or discharge of radioactive gases, liquids or solids is permitted

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

E. **Discharge or storage of petroleum products** - Not found in Diagnosis; Zoning § 5.9

1. **Prohibitions**

   ****

2. **Restrictions**

   The storage of fuel shall conform to all state and federal regulations and guidelines

3. **Exceptions and/or Exemptions**

   ****

4. **Limiting Distance**

   ****

F. **New above ground and underground petroleum storage facilities; New petroleum tanks which expand the capacity of existing facilities** - Not found in Diagnosis; Zoning § 5.9

1. **Prohibitions**

   ****

2. **Restrictions**

   No underground storage tanks shall be installed or replaced for residential use unless they comply with the DEC regulations for tanks over 1000 gallons

3. **Exceptions and/or Exemptions**

   ****

4. **Limiting Distance**

   ****

G. **New home heating oil tanks -** ****

1. **Prohibitions**

   ****

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

4. **Limiting Distance**

   ****

H. **New above ground and underground petroleum storage tanks of 185 gallons or more (gas stations) -** Diagnosis p.13 ; Zoning § § 5.9, 5.26

1. **Prohibitions**

   ****

2. **Restrictions**

   a) Tanks containing 550 to 10,000 gallons of fuel shall not be closer than 75 feet from any property line. Tanks larger than 10,000 shall not be less than 100 feet from a property line

3. **Exceptions and/or Exemptions**

   ****

4. **Limiting Distance**

   ****

I. **Discharge or storage of pesticides -******

1. **Prohibitions**

   ****

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

J. **Application or storage of fertilizers -** ****

1. **Prohibitions**

   ****

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

K. **Miscellaneous Point Sources (Industrial facilities, vehicle washing facilities, any new point source)** - Diagnosis p. 13 ; Zoning § 5.26

1. **Prohibitions**
   Car washing, repair and painting facilities are not permitted as accessory uses to gasoline stations

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

L. **Snow disposal and storage: Use of winter highway maintenance materials** – Diagnosis p. 6 ; Zoning § 3.3

1. **Prohibitions**
   Snow stockpiling except normal snow plowing and storage of chloride and nitrate salts or coal are prohibited in Conservation Agricultural Residential Districts

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

III. Solid waste, sewage and waste treatment

A. **Discharge or storage of human excreta** - Not found in Diagnosis ; Zoning § 5.2

1. **Prohibitions**
   ****

2. **Restrictions**

   Disposal of liquid and solid waste permitted only in accordance with applicable laws

3. **Exceptions and/or Exemptions**

   ****

B. Emptying, discharging or transferring the contents of a sewage receptacle – ****

1. **Prohibitions**

   ****

2. **Restrictions**

****

3. **Exceptions and Exemptions**

   ****

C. **Wastewater treatment plants: Construction, design and operation** – ****

1. **Prohibitions**
   ****

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

D. **Sewerage systems and services connections: Design, construction and operation** – (Not found in Diagnosis); Subdivision §51.2

1. **Prohibitions**
   ****

2. **Restrictions**

   a) Facilities for water and sewerage shall be provided in each new subdivision in accordance with the requirements of the appropriate agency having jurisdiction over the planning and installation of those in the area of the subdivision. Minimum requirements of the town shall be met.

3. **Exceptions and/or Exemptions**

   ****

E. **Intermediate sized and individual subsurface sewage treatment systems (septic tanks): Design, treatment, construction, maintenance & operation** - Diagnosis p. 6 ; Zoning § 4.4

1. **Prohibitions**
   a) No septic tanks permitted on lots less than 20,000 feet

   b) No septic tank shall be permitted in low, swampy areas with a high water table, areas with ledge rock or areas subject to flooding

   c) Disposal of the contents of cesspools and septic tanks is not permitted within the town

2. **Restrictions**

   Septic tank installation shall conform to requirements of the Dutchess County Department of Health

3. **Exceptions and/or Exemptions**

Pumping of cesspools and septic tanks is permitted

4. **Limiting Distance**

****

F. **Solid waste (Junkyards, automotive repair or scrap facilities, municipal solid waste landfill)** – Diagnosis p. 13 ; Zoning § 5.33

1. **Prohibitions**
No privately owned landfills or transfer stations permitted within the town

2. **Restrictions**

****

3. **Exceptions and/or Exemptions**

Landfills and transfer stations may be owned by the town

4. **Limiting Distance**

****

IV. New construction and development

A. **Construction of impervious surfaces (buildings, parking lots, sidewalks, paths, trails, etc.)** – Diagnosis p. 4 ; Zoning § 5.36

1. **Prohibitions**
****

2. **Restrictions**

a) All parking facilities shall be graded, surfaced, drained and maintained to avoid nuisances of dust, erosion or excessive water flow- Maximum slope shall be 5%

b) Thermal pollution of adjacent watercourses from runoff shall be minimized

3. **Exceptions and/or Exemptions**

****

4. **Limiting Distance**

****

B. **New individual residence** –****

1. **Prohibitions**
****

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   ****

4. **Limiting Distance**

   ****

C. **Roads and driveways (Street layout and design)** – Not found in Diagnosis ; Subdivision § 31

1. **Prohibitions**
   ****

2. **Restrictions**

   a) Existing natural features shall be preserved insofar as possible

   b) Streets shall relate to original topography and avoid sharp curves and steep grades

3. **Exceptions and/or Exemptions**

   ****

4. **Limiting Distance**

   ****

D. **Residential density and lot coverage (special districts)** – Diagnosis p. 14 ; Zoning §§ 2.5, 5.16

1. **Prohibitions**
   ****

2. **Restrictions**

   a) Three low density Agricultural Residential Districts are established:

      1) Conservation Agricultural Residential (C)

      2) Very Low Density Residential (AR5)

      3) Low Density Residential (AR3)

   b) Greater flexibility is given to bulk requirements in a Residential Cluster Development

3. **Exceptions and/or Exemptions**

   ****

E. **Commercial/industrial density and lot coverage** – ****

1. **Prohibitions**
****

2. **Restrictions**

****

3. **Exceptions and/or Exemptions**

****

F. Building on shallow soils/blasting activities - ****

1. **Prohibitions**
****

2. **Restrictions**

****

3. **Exceptions and/or Exemptions**

****

G. Tree or shrub removal - ****

1. **Prohibitions**
****

2. **Restrictions**

****

3. **Exceptions and/or Exemptions**

****

H. Alterations of wetlands or watercourses – Diagnosis p. 17, 18 ; Zoning § § 5.44, 5.51

1. **Prohibitions**
****

2. **Restrictions**

   a) Alteration of a wetland requires an erosion control plan

   b) To the extent practicable, adverse alteration of a wetland, watercourse, lake or pond to be minimized

3. **Exceptions and/or Exemptions**

The following activities are exempt from provisions intended to minimize alteration:

a) Deposition or removal of natural products of the wetlands and adjacent areas by certain recreational and commercial activities

b) Ordinary maintenance and repair of existing structures or improved areas which do not involve expansion or substantial modification

c) Public health activities

d) Any actual or ongoing emergency

e) Application of non-polluting chemicals and dyes for the purpose of maintenance

f) Most accepted agricultural practices

4. Limiting Distance

****

I. Development on or near wetlands or watercourses – (Not Found in Diagnosis); Zoning §§ 3.6, 4.11, Subdivision § 33.1

1. Prohibitions

****

2. Restrictions

a) At least 75% of the minimum lot area shall not consist of wetlands

b) Where a watercourse seperates a buildable area, provisions shall be made for the installation of a culvert

3. Exceptions and/or Exemptions

****

4. Limiting Distance

Stream buffer of 100 feet required in Medium Density Residential District

J. Development or activities in or near floodplains – Diagnosis p. 17 ; Zoning §§ 2.5, 4.11, 5.44, 5.51

1. Prohibitions

****

2. Restrictions

a) Residences and livestock restricted in the designated Floodplain District

b) At least 75% of the minimum lot area shall not consist of floodplains

c) Development in floodplains requires an erosion control plan

d) To the extent practicable, adverse alteration of a floodplain should be minimized

3. **Exceptions and/or Exemptions**

The following activities are exempt from provisions intended to minimize alteration:

a) Deposition or removal of natural products of the wetlands and adjacent areas by certain recreational and commercial activities

b) Ordinary maintenance and repair of existing structures or improved areas which do not involve expansion or substantial modification

c) Public health activities

d) Any actual or ongoing emergency

e) Application of non-polluting chemicals and dyes for the purpose of maintenance

f) Most accepted agricultural practices

4. **Limiting Distance**

****

K. **Destruction or impact on wildlife habitats** – Diagnosis p.18 ; Zoning § § 5.45, 5.51

1. **Prohibitions**

****

2. **Restrictions**

To the extent practicable, adverse alteration of a wetland, watercourse, lake, pond or floodplain shall be minimized in order to protect habitats and breeding environments

3. **Exceptions and/or Exemptions**

a) The following activities are exempt from provisions intended to minimize alteration:

(1) Deposition or removal of natural products of the wetlands and adjacent areas by certain recreational and commercial activities

(2) Ordinary maintenance and repair of existing structures or improved areas which do not involve expansion or substantial modification

(3) Public health activities

(4) Any actual or ongoing emergency

(5) Application of non-polluting chemicals and dyes for the purpose of maintenance

(6) Most accepted agricultural practices

b) Creation of trials, paths or corridors for the purpose of non-vehicular human recreation or the maintenance of wildlife migration routes or habitats are exempt from steep slope regulations

L. Development on steep slopes (grades > 15%) – Diagnosis pp. 17, 18 ; Zoning §§ 5.44. 5.45

1. Prohibitions

****

2. Restrictions

a) Development on slopes greater than 15% requires an erosion control plan

b) Steep slopes of 15-25% (moderate slopes) and greater than 25% (extremely steep slopes) are regulated

3. Exceptions and/or Exemptions

a) Customary landscaping not involving grading

b) Removal of diseased or dead timber or other vegetation subject to routine forest management practices

c) Creation of trials, paths or corridors for the purpose of non-vehicular human recreation or the maintenance of wildlife migration routes or habitats

d) Activities for which a special permit for excavation or mining is in effect

e) Accepted agricultural practices

4. Limiting Distance

****

M. Drainage requirements - Diagnosis p. 28 ; Subdivision § 34.6

1. Prohibitions

****

2. Restrictions

a) Storm drainage plans must reflect potential surface run-off and comply with Town Engineer requirements

b) If lot transversed by a water, need a storm easement or drainage right-of-way wide enough to encompass the 25 year flood area.

c) Right of way for storm drainage must be sufficient for facilities to handle runoff.

3. **Exceptions and/or Exemptions**

****

N. Extraction or removing of natural resources (mining, sand, rock, gravel) – Diagnosis p.p. 12 ; Zoning §§ 5.23, 5.38, 5.44

1. **Prohibitions**

****

2. **Restrictions**

a) Permitted in only the Office-Light Industry District or as non-conforming use

b) Activities are regulated by the NY DEC

c) Excavation for building a pond or lake of water surface larger than 1 acre requires a permit

d) Excavation of greater than 200 cubic yards requires an erosion control plan

3. **Exceptions and/or Exemptions**

a) Excepted agricultural practices

b) Excavation for the sole purpose of building a pond or lake where the material is returned to the same site

c) Activities performed for or by the town

d) Excavation for building construction, sewage disposal systems or underground storage tanks, or activities for a limited duration

e) Excavation for the purposes of installing public utilities and roads

f) Dredging operations under the jurisdiction of the U.S. Army Corp of Engineers

O. Development on or near aquifers – Diagnosis p. 17 ; Zoning § 3.3

1. **Prohibitions**

No proposed action in a Conservation Agricultural Residential District shall:

a) Alter subsurface flow of groundwater

b) Degrade the quality of surface and groundwater through the introduction of sewer wastes, storm runoff, chemicals, petroleum products, etc.

c) Increase the risk of water contamination

2. **Restrictions**

****

3. **Exceptions and/or Exemptions**

   Animal waste is excluded from the regulations in the Conservation Agricultural Residential District

P. **Grading, clearing or filling** – Diagnosis p. 17 ; Zoning § 5.44

1. **Prohibitions**
   ****

2. **Restrictions**

   Grading of greater than 200 cubic yards requires an erosion control plan

3. **Exceptions and/or Exemptions**

   ****

Agricultural and animal activities

A. **Agricultural activities** - Diagnosis p. 16 ; Zoning § 5.24

1. **Prohibitions**
   ****

2. **Restrictions**

   ****

3. **Exceptions and/or Exemptions**

   Since farming is so essential to the town, it is exempted from certain regulations. Notice must be given to prospective neighbors as to the nature of the activities

B. **Commercial farms and stables** - Diagnosis p. __ ; [ORDINANCE NAME] § __

1. **Prohibitions**
   ****

2. **Restrictions**

   Manure within 200 feet of any public water supply or state regulated wetland shall be stored in a structure designed to prevent leaching

3. **Exceptions and/or Exemptions**

   ****

C. **Commercial kennels** - Diagnosis p. 11 ; Zoning §§ 5.32

1. **Prohibitions**
   No nuisance shall be caused by the facilities

2. **Restrictions**

   Facilities shall be kept sanitary at all times

3. **Exceptions and/or Exemptions**

   ****

D. **Animal waste** – Diagnosis p. __ ; [ORDINANCE NAME] § __

1. **Prohibitions**
   ****

2. **Restrictions**

   Manure shall be stored in a manner to prevent leaching when it is within 200 feet of public water supply, lake or state regulated wetland

3. **Exceptions and/or Exemptions**

   Animal waste excluded from the restrictions in the Conservation Agricultural Residential District

Plans and management

A. **Local stormwater protection plans**

   ****

B. **Stormwater management** - Diagnosis p. 26 ; Subdivision § 51.3

C. **Discharge of stormwater and sediment; stormwater pollution prevention plans** (erosion and sedimentation control)- Diagnosis p. 17 ; Zoning § 5.44

Boards, inspectors and enforcement

(*Note: The only information necessary is whether the municipality has or has authorized the below categories*)

A. **Environmental inspector** - ****

B. **Conservation advisory council or board** – (Not found in Diagnosis) ; Zoning § 7.12

C. **Other environmental protection or preservation committees** - ****

D. Enforcement provisions or environmental compliance – Diagnosis p. 32; Zoning Article 7

Zoning techniques

(*Note: The only information necessary is whether the municipality has or has authorized the below categories*)

A. Agricultural district – (Not found in Diagnosis); Zoning § 5.6

B. Overlay zones – ****

C. Transfer of development rights - ****

D. Incentive zoning - ****

E. Floating zones - ****

F. Cluster development – Diagnosis p. 14 ; Zoning § 5.16

G. Conservation easements – ****

Separate ordinances

(*Note: list only the chapter number where the separate ordinance is found*)

A. Erosion and sediment control ordinance – ****

B. Tree ordinance - ****

C. Steep slope ordinance - ****

D. Watershed zoning or protection ordinance - ****

E. Wetlands ordinance - ****

Appendix 9: Geographic Information System Data Sources

COVER DESCRIPTION	SOURCE CITATION
State Pollution Discharge Elimination Systems (SPDES) Facilities	DCEMC GIS Lab automated, 1998
Road and Road Labels	New York State Department of Transportation
Streams	DCEMC GIS Lab automated from New York State Department of Environmental Conservation Biological Survey Series
Surficial Water	DCEMC GIS Lab automated from New York State Department of Environmental Conservation Biological Survey Series
State Wetland	Department of Environmental Conservation, Division of Fish and Wildlife, Habitat Inventory Unit created in 1994
Federal Wetland	US Fish and Wildlife Service, Digital Line Graph files, October 1995
Sub-watershed Boundary	DCEMC GIS Lab delineated and digitized boundaries using USGS topo quads

Wappinger Creek Watershed Natural Resource Management Plan for the Wappinger Creek Watershed Addendum One

Wappinger Creek Subwatershed Nonpoint Source Pollution Identification Project Data, 1998 - 1999

DAVID J. BURNS, THOMAS R. LYNCH, DALENE M. VARNEY

The Wappinger Creek subwatershed study of potential sources of phosphate, nitrate, suspended material, and fecal coliform bacteria was conducted from January 1998 to January 2000 as part of the Dutchess County (NY) Environmental Management Council's (DCEMC) nonpoint source pollution identification and abatement program. The overall goal of the abatement program was to implement watershed-wide planning based on intermunicipal cooperation. The primary objective of the study was to identify the land uses that contributed the greatest amounts of nonpoint source pollution. Secondly, the study determined levels of nutrients, suspended materials, fecal coliform bacteria, and baseline chemical characteristics of the Wappinger watershed.

The study allowed the DCEMC to identify the primary nonpoint source pollutant(s) in the sixteen Wappinger Creek subwatersheds. Pollutant identification allowed the DCEMC to determine which best management practices could benefit the differing subwatersheds. Additionally, the study provided the watershed partners with a scientific basis for implementation of their nonpoint source pollution abatement program.

Wappinger Creek Subwatershed Nonpoint Source Pollution Identification Project Data

Upton Lake Creek - UL .38 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	Notes
1/12/99	0.50	2.18	0.019	3.1	NA	5.9	0.25	
2/11/99	0.48	2.11	0.017	0.8	0	11.1	1.75	
3/10/99	0.41	1.82	0.014	1.3	10	15.1	3.5	
5/24/99	0.22	0.98	0.023	6.3	1210	9.5	13	
6/23/99	0.65	2.88	0.036	0.1	200	1.1	13.5	
6/29/99	0.68	2.98	0.013	2.3	200	1.0	16.5	
8/4/99	0.75	3.32	0.059	1.6	260	0.2	14.5	
8/26/99	0.18	0.78	0.053	8.9	NA	3.0	16	Event
9/16/99	0.33	1.45	0.062	5.6	1760	0.7	13	Floyd First Flush
9/17/99	0.49	2.15	0.063	10.4	NA	65.9	12.5	Floyd Peak Flow
9/30/99	0.23	0.99	0.041	7.6	4540	29.6	12.75	Event
10/4/99	0.17	0.73	0.040	28.1	4650	6.1	11.5	Event
11/23/99	0.46	2.01	0.035	0.5	0	4.4	12	
Tamarack Swamp Creek - Tam .02 Miles								
					Fecal			
	NO3-N	NO3	P-PO4	Suspended	Coliforms	Discharge	Temperature	
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	Notes
1/12/99	NA	NA	NA	NA	NA	NA	NA	Wasn't Sampled
2/10/99	0.62	2.72	0.023	0.1	20	7.8	1.75	
3/10/99	0.67	2.93	0.016	0.5	0	9.6	1.25	
5/24/99	0.24	1.06	0.038	3.3	440	6.1	12.25	
6/23/99	0.20	0.88	0.040	3.1	600	1.2	16	
8/4/99	0.32	1.39	0.074	2.4	90	0.3	14.5	
8/26/99	0.19	0.84	0.070	35.4	26000	3.9	14.5	Event
9/16/99	0.16	0.71	0.063	40.0	10710	3.7	13.5	Floyd First Flush
9/17/99	0.29	1.28	0.095	13.6	NA	42.7	11.75	Floyd Peak Flow
9/30/99	0.28	1.23	0.049	2.4	1250	9.3	14	Event
10/4/99	0.17	0.73	0.044	6.9	1870	3.8	13	Event
11/23/99	0.24	1.07	0.027	0.5	0	3.4	10	
Dutchess County Airport - DCA .29 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	Notes
1/13/99	NA	NA	NA	0.4	NA	7.54	NA	Wasn't Preserved
2/11/99	0.56	2.46	0.032	3	0	15.34	1.25	
3/11/99	0.46	2.03	0.019	1.2	10	15.81	1.75	
5/25/99	0.23	1.00	0.046	5.7	1010	22.09	12.5	
6/24/99	0.76	3.34	0.025	0.64	0	0.48	20.5	
6/29/99	0.85	3.76	0.019	5	2,630	1.116	22	
8/3/99	0.11	0.50	0.020	3.371	270	0.225	20	
8/26/99	0.19	0.84	0.075	55.00	NA	52.29	21	Event
9/16/99	0.93	4.08	0.148	17.00	7770	24.24	14	Floyd First Flush
9/17/99	0.46	2.04	0.092	44.80	NA	112.4	12.5	Floyd Peak Flow
9/30/99	0.56	2.47	0.066	8.4404	2710	70.46	15	Event
10/4/99	0.49	2.14	0.067	9.7653	2030	8.9	12.5	Event
11/23/99	0.37	1.61	0.029	3.0769	50	7.419	11	

Wappinger Creek Subwatershed Nonpoint Source Pollution Identification Project Data

East Branch, Wappinger Creek - EB .08 Miles								
					Fecal			
	NO3-N	NO3	P-PO4	Suspended	Coliforms	Discharge	Temperature	
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	Notes
10/7/97	0.28	1.24	0.056	2.6	NA	3.4	NA	
11/11/97	0.25	1.12	0.059	NA	NA	49.5	NA	
12/17/97	0.42	1.83	0.032	2.3	NA	24.0	NA	
1/8/98	0.17	0.74	0.072	6.4	NA	104.6	NA	Event
1/28/98	0.57	2.50	0.000	5.9	NA	67.1	NA	
2/23/98	0.44	1.94	0.046	5.6	NA	46.6	NA	
3/9/98	0.40	1.75	0.029	23.8	NA	95.5	NA	Event
4/1/98	0.30	1.30	0.026	5.1	NA	62.3	NA	
4/29/98	0.19	0.85	0.019	3.7	NA	45.5	NA	
5/26/98	0.27	1.19	0.035	6.8	NA	37.2	NA	
6/12/98	0.33	1.44	0.041	3.8	NA	17.1	NA	
6/15/98	0.19	0.84	0.045	10.7	NA	68.2	NA	Event
6/30/98	0.43	1.91	0.055	NA	NA	75.7	NA	Event
8/4/98	0.34	1.50	0.086	NA	NA	6.7	NA	
8/11/98	0.47	2.08	0.115	NA	NA	5.6	NA	
9/17/98	0.31	1.36	0.067	NA	NA	3.1	NA	
10/5/98	0.26	1.16	0.030	NA	NA	4.1	NA	
1/12/99	0.68	2.97	0.046	1.0	NA	24.5	0.25	
2/10/99	0.59	2.61	0.043	2.3	0	37.8	2.25	
3/11/99	0.47	2.06	0.047	1.5	10	48.7	0.25	
5/25/99	0.27	1.19	0.062	6.6	650	61.6	13	
6/23/99	0.23	1.00	0.042	3.9	200	8.4	16	
6/29/99	0.28	1.23	0.032	6.1	400	9.2	19.5	
8/4/99	0.08	0.35	0.091	3.2	30	3.4	19.25	
8/26/99	0.11	0.50	0.066	14.0	390	11.5	16	Event
9/16/99	0.17	0.76	0.075	10.8	1070	34.0	12	Floyd First Flush
9/17/99	0.20	0.88	0.074	33.8	NA	328.2	11	Floyd Peak Flow
9/30/99	0.24	1.06	0.078	7.8	2220	104.4	14	Event
10/4/99	0.27	1.18	0.059	2.3	NA	28.6	12	Event
11/23/99	0.17	0.77	0.018	13.3	20	32.9	10.5	
Italicized = Projected Flow - Provisional data, subject to review								
Cold Spring Creek - CS 1.27 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	Notes
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	
1/12/99	0.45	1.96	0.022	0.50	NA	14.6	0.5	
2/10/99	0.16	0.72	0.012	0.40	30	18.8	1.75	
3/10/99	0.18	0.80	0.012	0.90	0	20.0	0.5	
5/24/99	0.08	0.36	0.023	1.60	310	24.8	11	
6/22/99	0.08	0.35	0.016	0.45	NA	3.1	15.5	
8/3/99	0.05	0.23	0.039	2.67	60	0.7	16.5	
8/26/99	0.06	0.27	0.044	2.45	NA	1.2	15.5	Event
9/16/99	0.03	0.13	0.035	2.01	520	1.1	14.25	Floyd First Flush
9/17/99	0.27	1.19	0.064	6.57	NA	108.4	11.5	Floyd Peak Flow
9/30/99	0.09	0.42	0.032	0.37	720	11.1	12	Event
10/4/99	0.11	0.50	0.044	0.66	NA	9.7	10.5	Event
11/23/99	0.13	0.56	0.040	0.85	20	6.7	9.75	

Wappinger Creek Subwatershed Nonpoint Source Pollution Identification Project Data

Hunns Lake Creek HL .34 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	**mg/L**	**mg/L**	**mg/L**	**Solids - mg/L**	**Per 100/mL**	**CFS**	**Degrees C**	**Notes**
1/12/99	0.70	3.09	0.021	1.4	NA	10.5	0.25	
2/10/99	0.70	3.10	0.021	1.7	40	18.5	3	
3/9/99	0.65	2.88	0.013	1.5	0	12.9	1	
5/24/99	0.35	1.54	0.033	2.6	780	11.4	11.5	
6/22/99	0.72	3.15	0.029	0.6	NA	2.8	12	
6/29/99	0.54	2.38	0.058	2.1	800	2.2	15	
8/4/99	0.32	1.43	0.043	1.1	200	0.4	14	
8/26/99	0.23	1.00	0.057	15.3	3190	5.1	14	Event
9/16/99	0.41	1.80	0.066	20.6	1630	3.7	12.5	Floyd First Flush
9/17/99	0.38	1.67	0.064	27.6	NA	64.1	11.75	Floyd Peak Flow
9/30/99	0.56	2.48	0.111	21.4	15820	15.2	13	Event
10/4/99	0.59	2.59	0.133	132.7	21700	6.2	11	Event
11/23/99	0.50	2.22	0.024	0.9	20	4.2	10.5	
Grist Mill Creek - GM .02 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	**mg/L**	**mg/L**	**mg/L**	**Solids - mg/L**	**Per 100/mL**	**CFS**	**Degrees C**	**Notes**
1/13/99	NA	NA	NA	NA	NA	NA	NA	Not Sampled
2/10/99	0.27	1.17	0.018	0.3	20	12.5	2.5	
3/10/99	0.19	0.82	0.023	1.2	0	9.3	2.5	
5/24/99	0.04	0.18	0.035	4.2	640	11.2	12	
6/23/99	0.21	0.91	0.022	0.5	700	0.1	13.5	
8/4/99	0.03	0.15	0.057	3.6	580	No Flow	13.25	
8/26/99	0.12	0.52	0.059	17.7	NA	0.1	14	Event
9/16/99	0.07	0.32	0.068	5.4	10750	0.0	13.75	Floyd First Flush
9/17/99	0.51	2.24	0.095	6.0	NA	73.1	12	Floyd Peak Flow
9/30/99	0.58	2.57	0.031	6.5	2610	10.6	13.5	Event
10/4/99	0.07	0.30	0.050	20.1	NA	5.0	12	Event
11/23/99	0.05	0.22	0.029	0.2	20	2.8	11	
Willow Brook - WB .02 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	**mg/L**	**mg/L**	**mg/L**	**Solids - mg/L**	**Per 100/mL**	**CFS**	**Degrees C**	**Notes**
1/13/99	NA	NA	NA	NA	NA	NA	NA	Not Sampled
2/10/99	1.09	4.79	0.039	0.9	0	5.4	4	
3/10/99	0.94	4.15	0.022	1.9	20	8.1	3.5	
5/24/99	0.32	1.39	0.045	4.0	3760	5.1	11.5	
6/22/99	1.23	5.41	0.054	1.0	0	0.1	14	
8/4/99	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dries Up in Low Flow Yrs.
8/26/99	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Event
9/16/99	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Floyd First Flush
9/17/99	1.04	4.58	0.132	5.6	NA	38.2	12	Floyd Peak Flow
9/30/99	0.79	3.48	0.232	6.7	16500	9.0	13.5	Event
10/4/99	0.55	2.43	0.216	31.9	56800	2.4	11	Event
11/23/99	1.25	5.48	0.022	2.7	30	1.5	12	

Wappinger Creek Subwatershed Nonpoint Source Pollution Identification Project Data

Great Spring Creek GS .40 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	Notes
1/13/99	NA	NA	NA	NA	NA	NA	NA	Not Sampled
2/11/99	0.38	1.66	0.040	2.5	20	18.7	1.25	
3/11/99	0.26	1.15	0.010	1.0	10	20.9	1.5	
5/25/99	0.08	0.33	0.039	4.0	1490	22.9	12	
6/23/99	0.95	4.18	0.043	1.5	1600	1.5	16	
6/29/99	1.42	6.25	0.032	9.7	1,000	1.9	17.5	
8/3/99	0.72	3.17	0.053	1.8	610	0.3	15.75	
8/26/99	0.45	1.97	0.091	7.2	NA	2.0	19	Event
9/16/99	0.73	3.22	0.071	12.1	6000	4.0	13	Floyd First Flush
9/17/99	0.68	2.99	0.114	7.2	NA	115.6	12	Floyd Peak Plow
9/30/99	0.26	1.15	0.059	6.0	4190	42.2	14	Event
10/4/99	0.14	0.60	0.059	5.1	1420	9.7	11.5	Event
11/23/99	0.29	1.28	0.027	0.7	40	8.6	NA	
Little Wappingers Creek - LW .06 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	Notes
1/13/99	NA	NA	NA	NA	NA	NA	NA	Not Sampled
2/11/99	0.21	0.93	0.020	3.7	50	50.5	1.5	
3/11/99	0.20	0.88	0.013	0.6	100	67.0	1.5	
5/25/99	0.07	0.30	0.030	4.5	590	71.8	12.25	
6/23/99	0.28	1.22	0.079	2.2	1500	4.8	16	
8/4/99	1.95	8.58	0.056	1.5	360	0.4	16.5	
8/26/99	0.28	1.23	0.090	28.3	NA	3.7	19	Event
9/16/99	0.34	1.48	0.074	6.3	3330	4.4	13	Floyd (First Flush)
9/17/99	0.31	1.36	0.060	22.7	NA	367.3	12	Floyd (Peak Flow)
9/30/99	0.09	0.39	0.041	1.2	1210	109.4	14.5	Event
10/4/99	0.06	0.26	0.044	4.1	1570	26.6	12	Event
11/23/99	0.14	0.63	0.032	0.3	80	17.1	8.5	
Pleasant Valley East - PVE .08 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	Notes
1/13/99	NA	NA	NA	NA	NA	NA	NA	Site Added 4/1/99
2/11/99	NA	NA	NA	NA	NA	NA	NA	Site Added 4/1/99
3/11/99	NA	NA	NA	NA	NA	NA	NA	Site Added 4/1/99
5/25/99	0.12	0.53	0.051	5.8	740	28.5	10.25	
6/24/99	0.10	0.45	0.051	16.2	100	3.0	17	
8/3/99	0.34	1.49	0.099	2.4	100	0.2	17.25	
8/26/99	0.33	1.44	0.107	10.2	NA	2.9	19	Event
9/16/99	0.13	0.58	0.103	27.8	4100	7.3	13	Floyd First Flush
9/17/99	0.44	1.94	0.102	9.6	NA	147.2	13	Floyd Peak Flow
9/30/99	0.22	0.98	0.070	3.7	670	85.6	14	Event
10/4/99	0.19	0.84	0.081	0.6	NA	12.5	13	Event
11/23/99	0.06	0.28	0.050	0.6	30	5.9	8.5	

Wappinger Creek Subwatershed Nonpoint Source Pollution Identification Project Data

Mountain Road (Wappinger Creek Headwaters) - Wapp 33.85 Miles

Date	NO3-N mg/L	NO3 mg/L	PO4-P mg/L	Suspended Solids - mg/L	Fecal Coliforms Per 100/mL	Discharge CFS	Temperature Degrees C	Notes
10/7/97	0.01	0.03	0.048	28.4	NA	*0.5*	NA	
11/11/97	0.03	0.12	0.061	NA	NA	44.4	7	
12/17/97	0.09	0.39	0.059	3.5	NA	*9.1*	0.5	
1/8/98	0.05	0.22	0.065	5.9	NA	*42.5*	NA	Event
1/28/98	0.18	0.79	0.047	3.2	NA	18.7	0.5	
2/23/98	0.13	0.57	0.024	NA	NA	15.9	NA	
3/9/98	0.15	0.64	0.021	4.7	NA	*38.8*	NA	Event
4/1/98	0.06	0.28	0.033	4.6	NA	*25.0*	NA	
5/26/98	0.05	0.21	0.031	4.1	NA	*14.6*	15.5	
6/12/98	0.05	0.24	0.034	3.0	NA	*6.2*	16	
6/15/98	0.01	0.05	0.055	6.2	NA	*27.4*	17	Event
6/30/98	0.06	0.28	0.059	NA	NA	*30.6*	19.5	Event
8/4/98	0.01	0.05	0.177	NA	NA	*1.9*	NA	
8/11/98	0.02	0.10	0.116	NA	NA	*1.5*	NA	
9/17/98	0.03	0.14	0.098	NA	NA	*0.4*	13	
10/5/98	0.02	0.11	0.045	NA	NA	1.0	6.5	
1/12/99	0.25	1.10	0.067	2.5	NA	10.8	0.25	
1/27/99	0.30	1.30	0.037	1.6	10	36.5	1	
2/9/99	0.19	0.82	0.019	1.0	10	20.9	0.5	
2/24/99	0.29	1.26	0.029	1.2	20	15.8	0.75	
3/9/99	0.23	0.99	0.012	1.4	10	25.8	0.5	
3/17/99	0.12	0.53	0.011	6.4	0	30.3	4	
5/26/99	0.04	0.18	0.064	5.4	100	20.3	12.25	
5/27/99	0.06	0.25	0.063	6.3	120	17.1	12	
6/14/99	0.09	0.41	0.060	2.8	110	3.8	18	
6/24/99	0.06	0.27	0.041	1.7	200	3.0	16	
7/21/99	0.04	0.19	0.054	6.5	90	1.9	16.5	
8/3/99	0.03	0.12	0.110	10.0	10	0.9	15.75	
8/26/99	NA	NA	NA	NA	NA	NA	NA	Not Sampled
9/7/99	0.04	0.17	0.075	6.7	NA	1.7	16.5	
9/16/99	0.04	0.18	0.093	5.6	870	0.9	13	Floyd First Flush
9/17/99	0.04	0.16	0.097	7.0	NA	135.4	12	Floyd Peak Flow
9/21/99	0.04	0.18	0.110	3.4	90	14.9	13	
9/30/99	0.04	0.18	0.096	5.8	270	9.6	14	Event
10/4/99	0.05	0.20	0.085	5.1	NA	11.0	12.5	Event
11/3/99	0.05	0.23	0.030	2.8	60	11.0	12	
11/23/99	0.05	0.24	0.033	2.0	20	9.2	9.5	
12/14/99	0.08	0.35	0.030	1.6	51	13.1	1.75	

Italicized = Projected Flow (Q) - Provisional data, subject to review

Wappinger Creek Subwatershed Nonpoint Source Pollution Identification Project Data

Pleasant Valley (Main Stem) - Wapp 16.56 Miles

Date	NO3-N mg/L	NO3 mg/L	PO4-P mg/L	Suspended Solids - mg/L	Fecal Coliforms Per 100/mL	Discharge CFS	Temperature Degrees C	Notes
10/7/97	0.30	1.31	0.038	2.2	NA	*7.6*	NA	
11/11/97	0.08	0.36	0.044	NA	NA	252.3	7.5	
12/17/97	0.27	1.17	0.041	0.8	NA	*92.6*	0.75	
1/8/98	0.12	0.52	0.033	27.1	NA	*425.1*	NA	Event
1/28/98	0.47	2.08	0.018	1.2	NA	278.1	2.5	
2/23/98	0.32	1.39	0.019	1.9	NA	148.8	NA	
3/9/98	0.34	1.48	0.027	16.2	NA	*387.5*	NA	Event
4/1/98	0.25	1.10	0.024	4.1	NA	*250.6*	NA	
4/29/98	0.13	0.59	0.021	2.5	NA	*181.4*	11.25	
5/26/98	0.18	0.77	0.009	1.5	NA	*147.2*	17	
6/12/98	0.33	1.46	0.013	2.4	NA	*64.2*	16	
6/15/98	0.15	0.67	0.032	9.6	NA	*274.9*	16.5	Event
6/30/98	0.32	1.42	0.041	NA	NA	*305.9*	19	Event
8/4/98	0.49	2.14	0.075	NA	NA	*21.4*	NA	
8/11/98	0.45	1.97	0.054	NA	NA	*16.8*	NA	
9/17/98	0.26	1.12	0.048	NA	NA	*6.3*	15	
10/5/98	0.17	0.76	0.011	NA	NA	6.2	10	
2/9/99	0.45	1.96	0.028	1.9	10	223.8	0.75	
3/9/99	0.42	1.87	0.018	2.2	0	270.6	0.5	
5/26/99	1.05	4.62	0.040	3.7	160	198.9	11.75	
6/24/99	0.19	0.83	0.001	2.1	200	25.9	19	
8/3/99	0.07	0.33	0.047	0.8	80	7.1	19.75	
10/4/99	0.18	0.77	0.024	1.5	NA	113.6	12	Event
11/23/99	0.27	1.17	0.030	2.4	30	70.2	8.5	

Italicized = Projected Flow - Provisional data, subject to review

Wappinger Creek Subwatershed Nonpoint Source Pollution Identification Project Data

Red Oaks Mill - Wapp 8.01 Miles								
					Fecal			
	NO3-N	NO3	PO4-P	Suspended	Coliforms	Discharge	Temperature	
Date	mg/L	mg/L	mg/L	Solids - mg/L	Per 100/mL	CFS	Degrees C	Notes
10/7/97	0.27	1.17	0.044	2.17	NA	15	NA	
11/11/97	0.09	0.39	0.032	NA	NA	304	7	
12/17/97	0.32	1.43	0.035	2.06	NA	144	1.5	
1/8/98	0.09	0.37	0.048	35.74	NA	649	NA	Event
1/28/98	0.54	2.39	0.056	1.03	NA	414	1.5	
2/23/98	0.39	1.71	0.031	1.14	NA	286	NA	
3/9/98	0.42	1.83	0.025	28.91	NA	592	NA	Event
4/1/98	0.29	1.28	0.026	2.36	NA	384	NA	
5/26/98	0.23	0.99	0.012	1.89	NA	227	15.5	
6/12/98	0.41	1.82	0.027	2.22	NA	101	16	
6/15/98	0.18	0.81	0.023	10.04	NA	421	16.5	Event
6/30/98	0.34	1.51	0.034	NA	NA	468	20.25	Event
8/4/98	0.49	2.16	0.068	NA	NA	36	NA	
8/11/98	0.41	1.81	0.101	NA	NA	29	NA	
9/17/98	0.11	0.47	0.044	NA	NA	13	16.5	
10/5/98	0.14	0.62	0.036	NA	NA	10	11.5	
1/13/99	NA	NA	NA	1	NA	165	0.25	Not Preserved
2/9/99	0.52	2.31	0.024	1.7	7	352	0.75	
3/9/99	0.41	1.80	0.023	2.5	0	393	0.75	
5/26/99	0.17	0.76	0.044	2.5	200	309	11.25	
6/24/99	0.22	0.96	0.02	1.3	200	34	19	
6/29/99	0.45	1.98	0.028	55.57	NA	26	19	
8/3/99	0.07	0.30	0.05	4.327	60	6.9	19.75	
8/26/99	NA	NA	NA	NA	NA	36	NA	Not Sampled
9/16/99	0.10	0.44	0.056	4.501	5480	92	15	Floyd First Flush
9/17/99	0.35	1.54	0.075	33.2	NA	2050	12	Floyd Peak Flow
9/30/99	0.33	1.44	0.034	1.8182	1300	163	14.75	Event
10/4/99	0.24	1.07	0.034	4.3767	550	173	12.5	Event
11/23/99	0.19	0.85	0.023	1.0358	10	110	10	
Discharge - USGS gauging station at Red Oaks Mill site.								