APPENDIX B
Environmental

WAPPINGERS LAKE
WAPPINGERS FALLS, NEW YORK
APRIL 1993

ENVIRONMENTAL APPENDIX
Wappinger Lake, Wappinger Falls, N.Y.

I. Description of Proposed Project

The proposed project calls for a reconnaissance study to determine the extent and root causes of the problems limiting water quality and recreational use of Wappinger Lake.

II. Description of Study Area

Wappinger Lake is located in Dutchess County in the village of Wappinger Falls. It delineates the towns of Poughkeepsie to the northwest and Wappinger to the southeast. Wappinger Lake is an approximately 88 acre man-made freshwater lake formed by the impoundment of Wappinger Creek, a tributary of the Hudson River. The lake feeds into the Lower Wappinger Creek which in turn flows into the Hudson River approximately 62 miles north of New York Harbor.

Wappinger Creek is within the Wappinger watershed (Figure 1). The watershed comprises approximately 210 square miles within the Lower Hudson Sub-basin. The drainage area is approximately 30 miles long, from the town of Pine Plains toward New Hamburg at the southern tip of the town of Poughkeepsie. The creek, north of Wappinger Lake is fed by three primary branches; Little Wappinger, the Main (Wappinger) Branch, and the East Branch, all of which converse near Salt Point in the town of Pleasant Valley. The drainage basin includes large sections of the towns of Washington, Pine Plains, Milan, Stanford and Clinton. This upper basin is primarily rural in character, whereas the lower basin is much more urban resulting in the Creek receiving runoff from some of the county's most highly developed areas.

III. Present Conditions

Wappinger lake, after the raising of the height of the dam in 1914 by the Dutchess Bleachery had an approximate depth of fourteen (14) feet (History of Wappingers). Since that time the years of soil erosion from throughout the watershed with subsequent siltation has reduced the lake depth dramatically. Measurements taken by the Dutchess County Department of Planning in as early as 1972 shows a significant portion of the lake with reduced depths of five and a half to seven (5.5-7.0) feet and smaller areas nearer the shore with a lake depth of under five feet. By 1981 rough results in a draft of over two feet. Water chestnuts grow in many areas of the lake which have become too shallow for the harvester to enter. Reduced lake depth in conjunction with the harvester's limitations have resulted in poor water chestnut control.

The Lake sedimentation processes and algael blooms are both results of activities not limited to the Village of Wappinger Falls, but which occur throughout the watershed. Thomas described this situation very clearly in "Natural Resources of Dutchess County" (Thomas, 1985), "Upstream erosion and pollution are gradually choking many of the county's lakes and ponds. Materials carried downstream fill the lakes with silt and accelerate the natural eutrophic process through which lakes evolve into dry land." Soil loss in Wappinger Creek alone has been estimated at 107,849 tons/year (USDA, 1974). Erosion rates have been examined by USDA for different land uses (Table 2). Clearly, the uses which contribute most to soil loss within Dutchess County are construction, cropland use without conservation measures, and roadbanks.

Attempts to control algael blooms through the use of copper sulfate were somewhat effective in the past, but as effectiveness diminished so did its use. Control of watershed activities which contribute to the environmental degradation of Wappinger Lake, such as erosion and pollution discharges, have thus far been beyond the capacity of Wappinger Falls. Watershed management measures will be explored more fully in the Alternatives Section.

IV. Environmental Resources

a. <u>Water Resources:</u> The waters of Wappinger Lake were classified as Class B (bathing) by the New York State Department of Environmental Conservation (NYDEC), Division of Water in 1985 (NYDEC, 1985). Since that time higher coliform counts in combination with the water chestnut invasion have closed the lake for bathing.

Wappinger Lake supports a variety of warm water fish as well as macro and microphyte flora and fauna. Recently a mix of invertebrate life forms and phytoplankton collected in the lake and recorded by Associates of Marist College numbered forty nine (49) taxa. Wappinger Lake in turn feeds into Lower Wappinger Creek which supports an even larger diversity of life forms. Indeed, Wappinger Lake, Falls and tidal Wappinger Creek comprise one of the areas listed as "significant" by the Dutchess County Environmental Management Council (EMC). Impacts on the water quality of Wappinger Lake directly impacts the warmwater fishery and other habitats not only in the Lake but in the Lower Wappinger "significant area" in its entirety.

b. Wildlife Resources

1. Terrestrial fauna- No State or Federal listed endangered or threatened species are known to live or breed at Wappinger Lake. There are, however some endangered or threatened species among the many wildlife species with habitats within Dutchess County. Should activities geared towards solving the water quality problems of Wappinger Lake take place in other parts of the Wappinger watershed great care must be taken to identify the possible habitat impacts involved.

2. Fish resources- Based on several fish surveys conducted by NYDEC from 1963 through 1988 as well as the 1985 Survey of Fishkill Creek Drainage System (Schmidt and Kiviat, 1985) there appear to be over a dozen warm water fish species present at Wappinger Lake (Table 3). In addition, analysis for toxic substances in fish was carried out in the Lake by NYDEC as part of a statewide substances monitoring program in 1981. Results showed no evidence of toxic levels of PCB, DDT, Dieldrin, HCB, Endrin, Lindane, Mirex, Mercury, Chlordane or Heptachlor in fish. As previously mentioned, the waters of Wappinger Lake flow into the Lower Wappinger Creek, The species recorded at the Lower Creek are listed in Table 4.

3. Amphibian, Reptile and Mammal Resources- A considerable variety of amphibians and reptiles are known to inhabit Dutchess County and may occur in the study area or in a part of the watershed. A complete list is supplied in Table 5. Deer, eastern cottontail and grey squirrel are common in Dutchess County. Muskrats have been reported specifically in the Lower Wappinger Creek area.

c. Geology and Soils

1. Bedrock patterns- Wappinger Lake rests on a bedrock base of Austin Glen graywacke and shale (Fig. 2). which consists of thin to medium beaded coarse, dark grey sandstone or fine grained conglomerate of firmly cemented rounded fragments. Much of Wappinger Creek has a bedrock base of Wappinger Group; an elongated mass of carbonate rocks. The Wappinger

Group is often mined for crushed stone, agricultural limestone, riprap and stone sand.

2. Soils- Wappinger Lake is bordered primarily by urban developed land and the following soil types (Dutchess County Soil and Water Conservation District, 1991): Dutchess-Cardigan-urban land (DxC), Dutchess-Cardigan complex (DwD), Hoosic-Urban land complex (HuB), Knickerbocker fine sandy loam (KvA, KvB), and Wayland silt loam (Wy).

Dutchess-Cardigan-Urban land (DxC) is a rolling rocky soil with a 5-16% slope. It is a complex of Dutchess soils, which are very deep well drained loamy soils, Cardigan soils that are moderately deep and well drained, as well as urban land (which is characterized by poorly drained surfaces).

Dutchess-Cardigan complex (DwD) is a rocky soil with steep slopes (15-30%). It is a complex of the Dutchess and Cardigan soils described above.

Hoosic-Urban land complex (HuB) is a moderately (2-6%) sloped complex of Hoosic (very deep sandy over gravelly soils) and urban land.

Knickerbocker fine sandy loam soils,contiguous to the lake are either nearly level (KvA) or very mildly sloped (KvB). They consist of very deep somewhat excessively drained sandy soils.

Wayland silt loam (Wy) consists of very deep, nearly level poorly drained soils formed in recent alluvium. It has a very high (0.5-1.0 foot) water table, and is a HYDRIC soil. In general, there is a high correlation between this soil type and the existence of jurisdictional wetlands.

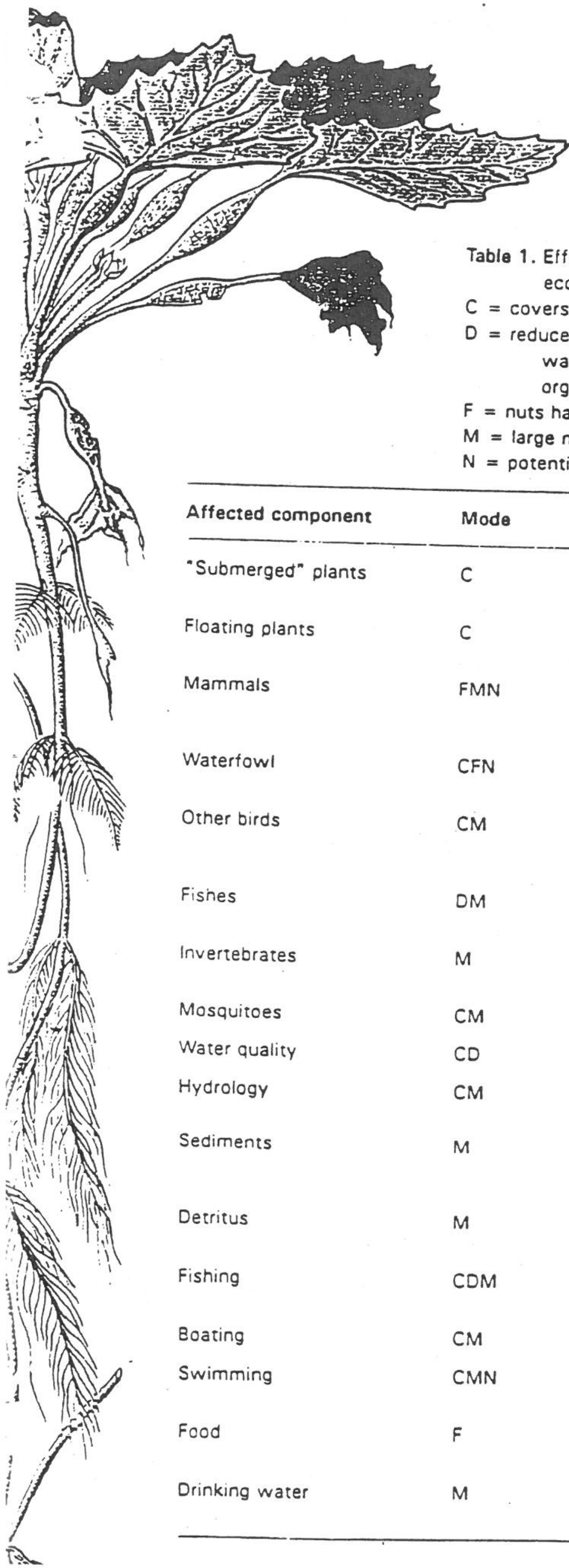
The upper portion of the Wappinger Creek drainage basin, most especially in the Stanford-Pine Plains area contains large steeply sloped (>15%) areas. Further down along Wappinger Creek the slopes are more moderate. Areas that most likely contribute heavily to soil erosion and sedimentation are those with high k factor (soil erodibility as a measure of the susceptibility of soils to erosion by water) in combination with steep slopes. Runoff in these areas is largely contributed to by agricultural or urban development. Figure 3 shows the extent of agricultural or urban development as well as steeply sloped areas along Wappinger Creek and its major tributaries. The extent of such areas implies non point source sediment and nutrient input over a large geographic area.

3. Lake Sediment- Sediment tests were carried out in Wappinger Lake for the presence of heavy metals and a series of pesticide/PCB organics both by the Department of Transportation in 1984 and 1986 (Litts, 1986), and the Army Corps of Engineers (with analysis by Energy & Environmental Engineering, Inc.) in 1992. All these tests showed no significant levels of the following compounds in Wappinger Lake: gamma-BHC, Endrin, Methoxychlor, Chlordane, Aroclor, Arsenic, Cadmium, Chromium, Copper, Lead, Zinc. Care was taken to replicate the sites for sampling to permit comparison of data. The sample sites are depicted in Figure 4. Results of the most recent sediment analysis are included in the Environmental Appendix. Levels of oil and grease as well as sulfates are included in the results.

d. Vegetative Communities

The vegetative communities around Wappinger Lake and the Lower Wappinger Creek are primarily forested upland and forested wetland (Palustrine Forested Wetland) with small areas of marshland (both Lacustrine emergent and Palustrine emergent wetlands). Table 6 lists the streamside association species (Palustrine system) of Dutchess County likely to be found along Wappinger Creek (Roberts, 1938).

Trees and shrubs of the Lake and Pond Associations (Lacustrine system) of Dutchess County are no longer all likely to be found at Wappinger Lake. A recent vegetative survey has not been carried out, and the invasion of water chestnut, along with other exotic species makes older detailed listings obsolete. The most prevalent plant species observed at Wappinger Lake are tulip tree (Liriodendron tulipifera), sycamore (Acer pseudoplatanoides), silky dogwood (Cornus amomum), purple loosetrife (Lythrum salicaria), cattails (Typha latifolia), phragmites (Phragmites communis), water milfoil (Myriophyllum spp.), sedges (Cyperaceae), arrowhead (Sagittaria latifolia), pickerelweed (Pontederia cordata), water chestnut (Trapa natans), and an assortment of duckweed (Lemna spp), pondweed (Potomogeton), and algae (Chlorophyceae, Cyanophyceae).



Water-chestnut plant, showing only 1 of several stalks and rosettes.

Table 1. Effects of water-chestnut on native biota and human society. Modes of ecological impact:

C = covers water surface

D = reduces dissolved oxygen by blocking movement of oxygen from air into water, and potentially by providing an abundance of quick-decaying organic matter in early autumn

F = nuts have high food value for animals that can open the husk

M = large masses provide dense cover below and just above water surface

N = potentially dangerous nut husks accumulate in sediments and on shorelines

Affected component	Mode	Impact of water-chestnut
"Submerged" plants	C	Shades out native & introduced species including Eurasian watermilfoil, wild-celery, clasping pondweed
Floating plants	C	Provides shelter for duckweeds & floating algae on quiet water between water-chestnut rosettes
Mammals	FMN	Nuts & rosette "core" eaten by muskrat, red & gray squirrels, Norway rat, probably eastern chipmunk; nuts possibly harmful if stuck in fur or stepped on
Waterfowl	CFN	Shades out native submerged food plants; nuts possibly dangerous if lodged in feathers or eaten
Other birds	CM	Songbirds eat associated insects; herons forage for small animals in water-chestnut beds; osprey may become tangled in water-chestnut[1]
Fishes	DM	Good shelter for early life stages of common, tolerant species, but poor habitat for declining sensitive species (see text)
Invertebrates	M	Habitat for worms, crustaceans, insects, spiders, mollusks, others (see text)
Mosquitoes	CM	Said to be good habitat for mosquito larvae[15]
Water quality	CD	Rapid decay in late summer can reduce dissolved oxygen
Hydrology	CM	Dense biomass slows currents, damps waves, & apparently maintains sheet of perched water in bays at low tide
Sediments	M	Water-chestnut masses trap silt & plant fiber, speeding filling of bays & ponds,[13] but may protect downstream waters from pollution
Detritus	M	Replaces fibrous, slow-decaying plants with soft, quick-decaying material
Fishing	CDM	Impossible to fish in beds; fishing for e.g. largemouth bass should be good around edges of beds or in hand-pulled areas
Boating	CM	Difficult or impossible to boat in water-chestnut beds
Swimming	CMN	Impossible to swim in water-chestnut beds; nuts hazardous to bare feet & ankles
Food	F	Nuts gathered from wild in many parts of Eurasia; cultivated in India, Southeast Asia
Drinking water	M	Organic matter from decaying water-chestnut may contribute to formation of toxic compounds during chlorination of water[3]

Table 2: Erosion Rates for Major Land Uses in Dutchess County

Land Use	Average Soil Loss (tons/acre/year)
Construction sites	9.61
Croplands without conservation measures	11.88
Orchards, vineyards	1.21
Urban lands	0.59
Croplands with conservation measures	0.74
Pasture	0.79
Woodland	0.48
Streambanks (/mile/year)	6.54
Roadbanks "	31.80

Table 3: Fish Species of Wappinger Lake

Scientific Name	Common Name
Ambloplites rupestris	Rock bass
Anguilla americana	American eel
Catostomus Commersoni	White sucker
Cyprinus carpio	Carp
Ictalurus nebulosus	Brown bullhead
Lepomis auritus	Red breasted sunfish
Lepomis gibbosus	Pumpkinseed sunfish
Lepomus macrochirus	Bluegill sunfish
Micropterus dolomieui	Smallmouth bass
Micropterus salmoides	Largemouth bass
Notomigonus chrysoleucas	Golden shiner
Notropis cornutus	Common shiner
Perca flavescensa	Yellow perch
Pomoxis nigromaculatus	Black crappie

Table 4: Fish Species of Lower Wappinger Creek

Scientific Name	Common Name
Alosa aestivales	Blueback herring
Alosa pseudoharengus	Alwewife herring
Alosa sapidissima	American shad
Anguilla americana	American eel
Catostomus commersoni	White sucker
Cyprinus carpio	Carp
Ethostoma olmstedi	Tasselated darter
Fundulus diaphanus	Banded killifish
Fundulus heteroclitis	Mummichog
Ictalurus cactus	White catfish
Lepomis auritus	Redbreast sunfish
Lepomis gibbosus	Pumpkinseed sunfish
Lepomis macrochirus	Bluegill sunfish
Micropterus salmoides	Largemouth bass
Morone americana	White perch
Morone saxatalis	Striped bass
Notemigonus chrysoleucas	Golden shiner
Notropis hudsonius	Spottail shiner
Perca flavescens	Yellow perch
Pomoxis nigromaculatus	Black crappie

Table 5: Amphibian and Reptile Species of Dutchess County and Threatened (T) or Endangered (E) Status

Amphibians

Scientific Name	Common Name	Status
Abystoma maculatum	Spotted salamander	
Abystoma tremblayi	Tremblay's salamander	
Abystoma opacum	Marbled salamander	
Abystoma laterale	Blue-spotted salamander	
Abystoma jeffersonianum	Jefferson salamander	
Abystoma platineum	Silvery salamander	
Bufer woodhousii	Fowler's toad	
Bufo americanus	American toad	
Desmognathus fuscus	Dusky salamander	
Eurycea bislineata	Two-lined salamander	
Hemidactylium scutatum	Four-toed salamander	
Hyla versicolor	Grey treefrog	
Hyla crucifer	Spring peeper	
Notophthalamus viridescens	Eastern newt	
Plethodon glutinosus	Slimy salamander	
Plethodon cinereus	Redback salamander	
Pseudotriton ruber	Red salamander	
Rana catesbeiana	Bullfrog	
Rana palustris	Pickerel frog	
Rana pipiens	Northern leopard frog	
Rana sylvatica	Wood frog	
Rana clamitans	Green frog	

Reptiles

Scientific Name	Common Name	Status
Chelydra serpentina	Snapping turtle	
Sternotherus odoratus	Musk turtle	
Kinosternon subrubrum	Mud turtle	T
Clemmys guttata	Spotted turtle	
Clemmys muhlenbergii	Bog turtle	E
Clemmys insculpta	Wood turtle	
Terrapene carolina	Eastern box turtle	
Chrysemys picta	Painted turtle	
Emydoidea blandingii	Blanding's turtle	T
Sceloporus undulatus	Eastern fence lizard	
Nerodia sipedon	Northern water snake	
Storeria dekayi	Brown snake	
Storeria occipitomaculata	Redbelly snake	
Thamnophis sauritus	Eastern ribbon snake	
Thamnophis ssirtalis	Common garter snake	
Heterodon platyrhinos	Eastern hognose snake	
Diadophis punctatus	Ringneck snake	
Carphophis amoensus	Worm snake	
Coluber constrictor	Black racer	
Opheodrys vernalis	Smooth green snake	

Elaphe obsoleta	Black rat snake	
Lampropeltis triangulum	Milk snake	
Agkistrodon contortix	Copperhead	
Crotalus horridus	Timber rattlesnake	T

Table 6: Streamside Association Species of Dutchess County

Scientific Name	Common Name
TREES	
Acer negundo	Box elder
Acer rubrum	Red maple
Acer saccharinum	Silver maple
Carpinus carolonianum	Ironwood
Carya cordiformis	Bitternut
Carya glabra	Pignut
Carya ovata	Shagbark hickory
Celtis occidentalis	Hackberry
Crataegus crus-galli	Hawthorn
Fraxinus americana	White ash
Fraxinus nigra	Black ash
Fraxinus pennsylvanica	Green ash
Juglans cinerea	Butternut
Juglans nigra	Black walnut
Liquidambar styraciflua	Sweetgum
Morus rubra	Red mulberry
Ostrya virginiana	Hop hornbeam
Platanus occidentalis	London Planetree
Prunus nigra	Canada plum
Quercus bicolor	Swamp white oak
Quercus macrocarpa	Bur oak
Quercus palustris	Pin oak
Salix babylonica	Weeping willow
Salix lucida	Shining willow
Salix nigra	Black willow
Tilia americana	Basswood
Ulmus americana	American Elm
Ulmus fulva	Slippery elm
SHRUBS	
Alnus incana	Hoary alder
Alnus rugosa	Smooth alder
Amelanchior canadensis	Shadbush
Amorpha fruiticosa	False indigo
Clematis virginiana	Virgin's bower
Clethrta alnifolia	Sweet pepperbush
Cornus amomum	Silky dogwood
Cornus stolinifera	Redosier dogwood
Hammemalis virginiana	Witch hazel
Ilex verticillata	Winterberry
Lindera benzoin	Spicebush
Menispermum canadense	Moonseed
Myrica gale	Sweetgale
Physocarpus opulifolius	Ninebark

Table 6: (cont.)

Scientific Name	Common Name
Psedera quiquefolia	Woodbine
Rosa carolina	Carolina rose
Rosa virginiana	Virginia rose
Salix discolor	Pussy willow
Sambucus canadensis	Elderberry
Solanum dulcamara	Bittersweet
Spirea latifolia	Meadowsweet
Spirea tomentosa	Steeplebush
Staphylea trifola	Bladdernut
Vibernum acerifolium	Mapleleaf viburnum
Viburnum dentatum	Arrowwood
Viburnum lentago	Nannyberry
Vitis cordifolia	Frost grape
Vitis vulpina	River bank grape
HERBS	
Acorus calumus	Sweetflag
Alisma plantago-aquatica	Water plantain
Anemone quinquifolia	Wood anemone
Angelica atropurpurea	Angelica
Arisaema dracontium	Green dragon
" incarnata	Jack-in-the-pulpit
Asarum canadense	Wild ginger
Ascelpias incarnata	Swamp milkweed
Aster spp.	Aster
Caltha palustris	Marsh marigold
Campanula aparanoides	" bluebell
Cassia marilandia	Wild senna
Chelone glabra	Turtlehead
Chrysoplenium americanum	Golden saxifrage
Claytonia virginica	Spring beauty
Convolvulus sepium	Hedge bindweed
Cystosperis fragilis	Bladder fern
Dentaria diphylla	Toothwort
Dicentra cucullaria	Dutchman's breeches
Dioscorea villosa	Wild yam root
Erythronium americanum	Yellow adder's tongue
Eupatorium perfiolatum	Joe-Pye weed
Eupatorium purpureum	Boneset
Gentiana andrewsii	Closed gentian
Habenaria lacera	Ragged fringed orchid
Habenaria psychodes	Fringed orchid
Helenium autimnale	Sneezeweed
Heracleum lanatum	Cow parsnip

Table 6 (cont.)

Scientific Name	Common Name
Hibiscus palustrus	Swamp hibiscus
Houstonia caerulea	Bluets
Humulus lupulus	Common hop
Hypericum ascyron	Great St. John's wort
Hypericum canadense	St. John's wort
Impatiens spp.	Impatiens
Iris prismatica	Slender blue flag iris
Iris versicolor	Blue flag iris
Lilium canadense	Wild yellow lily
Lilium philadeldphicum	Wood lily
Lobelia cardinalis	Cardinal flower
Lobelia siphilitica	Great lobelia
Lysimachia nummularia	Moneywort
Matteuccia struthiopteris	Ostrich fern
Mentha piperita	Peppermint
Mentha spicata	Spearmint
Mertensia virginica	Virginia cowslip
Mikania scandens	Climbing hemp-weed
Myostis laxa	Forget me knots
Myosotis scorpoides	True forget-me-nots
Oakesia sessifolia	Oakesia
Onoclea sensibilis	Sensitive fern
Orobanche uniflora	One flowered cancer root
Osmunda cinnamomea	Cinnamon fern
" claytonia	Interrupted fern
" regalis	Royal fern
Peltandra virginica	Arrow arum
Petasites palmatus	Sweet coltsfoot
Podophyllum peltatum	Mayapple
Polygonatum biflorum	Solomon seal
Polygonum convulvulus	Black bindweed
" scandens	Climbing false buckwheat
Pontederia cordata	Pickerelweed
Ranunculus spp	Buttercup
Rudbeckia lancianata	Coneflower
Sagittaria canadensis	Bloodroot
Scutellaria galericulata	Skullcap
" latiriflora	Mad-cap skullcap
Sicyos angulatus	One seeded bur cucumber
Sisyrinchium angustifolium	Blue-eyed grass
Sium cicutaefolium	Water parsnip
Smilacena racemosa	False spikenard
" stellata	" solomom seal
Smilax herbacea	Green brier
Solidago elliotii	Rough goldenrod

Table 6 (cont.)

Scientific Name	Common Name
Spiranthus romansoffana	Ladies tresses
Steironema cilatum	Yellow June lily
Symphytum officinalle	Common comfrey
Thalictrum spp.	Meadow rue
Thaspium aureum	Meadsow parsnip
Thelypteris noveboracensis	New York fern
Trillium spp	Trillium
Uvulvaria spp	Bellwort
Veratum viride	False hellebore
Verbena hastata	Blue vervain
Veronica americana	American brookline
" anagalis-aquatica	Water speedwell
" virginica	Culver's root
Viola spp.	Violet

V. Preliminary Recommendations for Alternatives

As we have determined the root causes of the problems limiting water quality and recreational use of Wappinger Lake extend far beyond the boundaries and resources of Wappinger Falls, N.Y. this alternative section will deal with both the programs Wappingers Falls might access for assistance, as well as potential problem solving measures.

a. Access the US Army Corps of Engineers (ACOE) for Assistance (i.e. dredging)- ACOE activities beyond a reconnaissance study must be justified by a positive benefits:costs ratio. Present guidance is that these benefits cannot be primarily low priority benefits. Unfortunately, water quality and recreational benefits are classified as low priority. The Army Corps of Engineers, is therefore, under present guidelines, unable to assist Wappinger lake.

A secondary consideration of ACOE in chosing its solution alternatives is the attempt to provide as long term a solution as possible. While dredging would certainly restore recreational use to Wappinger Lake through both lake deepening and removal of much of the invasive water chestnut, the benefits achieved would have a limited life span. Dredging would most probably not remove all the water chestnut fruiting bodies. Reinvasion would occur, and unless effective water chestnut control measures were put into effect water chestnut would quickly impede recreational use of the lake once again. As the water chestnuts act as an effective silt curtain, their presence would again accelerate the process of siltation of Wappinger Lake. In addition, while dredging would indeed remove nutrient rich sediments it would not impede the nutrient loading which occurs from runoff throughout the watershed. Algael blooms would most likely continue to be a persistent problem even after a dredging operation.

b. Access the Aquatic Plant Control Research Program (APCRP): The Aquatic Plant Control Research Program guidelines have been interpreted under similar lines as ACOE general guidance. APCRP will not take on a project whose primary benefit is low priority (in this case recreational). As this is clearly the case this program is unavailable to Wappinger Lake.

c. [redacted]

use clearly fall within the guidelines of EPA's Clean Lakes Program. The community of Wappinger Falls would however, benefit from a clear understanding of the workings of this program so that its utilization would be in a cost effective manner.

The Clean Lakes Program Coordinator for this region, Terry Faber (Faber, pers. com) was gracious to supply the following background information. The Clean Lakes Program functions in two phases. Phase I, the diagnostic and feasibility study followed by Phase II, actual implementation.

Phase I is by definition a fact finding or analysis phase. Its purpose is to supply the problem data and proposed plan of action. Funding for a Phase I study in no way guarantees continued funding for Phase II projects. The mechanism exists by which a local interest may apply directly to Phase II implementation, if they can supply the pertinent data directly.

Wappinger Falls has been attempting to deal with this problem for a considerable time. They may have already collected much of this information. It would be in the interest of the local government to review the attached "Cooperative Agreement for Protecting and restoring Publicly Owned Freshwater Lakes". Limited gaps in the data could be identified and filled most cost effectively with the assistance of local groups active in researching and/or managing water resources. An application could then be submitted, through The New York State Department of Environmental Conservation, directly for Phase II (implementation) project assistance.

A Phase II proposal may consist of several stages in problem solving. Such an approach may result in sufficient funding made available to solve a Clean Lakes problem over an extended period as opposed to tackling the entire problem in one fell swoop. A possible approach could be to develop both a short term, relatively limited plan, as well as a long-term comprehensive proposal. These plans could include some of the following measures:

1. Short-term improvement of Wappinger Lake for recreational use and water quality- Such an improvement would be dependent upon improved water chestnut control and decreased sediment and nutrient loading.

i. Airboat rosette removal- Airboats can be utilized to enter areas too shallow for a harvester to enter. A cutter blade can be attached so that as the airboat travels the rosettes (flowering bodies) are cut approximately four inches (4") below the water surface. By beginning this process just as the plant begins to break the water surface but before the rosettes are given the opportunity to form fully (approximately mid May to early June), and repeating it at two week intervals water chestnut nut production will be prevented. A distinct advantage to this process is the efficiency of the process. In the Albany area 15 acres of rosettes have been cut in one day (Madsen, pers. com).

This process will be extensive the first two seasons it is utilized. If however successful prevention of nut production is achieved only growth from previously dormant nuts will have to be controlled. As these nuts have approximately 90% germination the first year, and a viability of five years, after the first season after treatment commencement the quantity of rosettes to cut will be greatly reduced and control will become a much less time consuming process. Care must be taken to prevent reinvasion by failing to continue control measures.
Cost: equals cost of airboat plus labor. Much of the labor, and perhaps the airboat as well, may be obtained on a volunteer basis.

ii. Sediment covers- Areas too shallow for even an airboat to successfully traverse can achieve water chestnut control through the use of sediment covers, or gas permeable screens. Some screens on the market are Aquascreen, polypropylene, Dartok and even PVC liners (with cuts for gaseous exchange). The screens must be placed flush with the sediment surface and staked or anchored. The screens prevent light from reaching the sediment surface and thus prevent germination.
Cost: Estimates from 1988 range from $3,240-$8,700 per acre.

iii. Dredging- A dredging operation could be an effective short-term solution to the deteriorating recreational use of Wappinger Lake. Obviously, the greater the depth to which the lake is dredged the longer the grace period until sedimentation once again becomes problematic. Both control of water chestnut and algael blooms will be augmented for the short term. By removing the sediment we will have removed much of the water chestnut nuts as well as increased lake depth. At depths beyond approximately three meters (3m.) in somewhat turbid waters (SECCI depth 2 meters) water chestnut growth drops dramatically (Madsen, pers. com.). Internal nutrient loading from the sediment will also be reduced possibly leading to a reduction in algael blooms. These improvements will last only until sediment and nutrient loading, as well as water chestnut reinvasion, overtakes dredging's beneficial effects.

b. Sediment loading reduction- As we saw (Table 2) construction sites are large contributors to soil erosion. Such disturbed areas in close proximity to Wappinger Creek can be identified and short term sediment control achieved through the use of sediment traps. These traps, or temporary structures can be made of sandbags, straw bales or stone and may detain runoff for short periods of time so heavy sediment particles will settle out.

c. Nutrient loading reduction- Little reduction of nutrients can be achieved at the local level. Limited measures may include coordination by lake homeowners with local soil conservation experts on optimum fertilizer and pesticide use. Gutters should be removed so that runoff occurs over vegetated areas where nutrients can be taken up. More comprehensive effective measures will need to be included in the long term proposal.

2. Long-term comprehensive proposal- Any long-term proposal would need to incorporate watershed-wide management plans to reduce nutrient and sediment loadings. As nutrients and sediment enter Wappinger Creek from throughout the watershed as a sort of non point source pollution, control measures must address the issue throughout the watershed. Potential watershed management control measures may include:

a. Sediment loading reduction- This can be achieved either through reducing the amount of sediment entering Wappinger Creek and its tributaries (sediment diversion) and/or reducing the amount of sediment already within the Creek that reaches Wappinger Lake (sediment detention).

i. Sediment diversion- Diversion structures should be placed in those areas identified as the greatest sediment contributors. Potential areas of great sediment input are those adjacent to Wappinger Creek , and its tributaries, on steep slopes, and of soil types with relatively high soil erosion characteristics.

Using the Soil User's guide and associated soil maps (Dutchess County Soil and Water Conservation District, 1991) seven general geographic areas are among those characterized as both having steep slopes and contiguous to Wappinger Creek or its main tributaries. These areas are demarcated on the attached soil maps which act as overlays to the appropriate USGS quadrant maps.

I. Wappinger Falls quadrant- area northeast of Wappinger Lake
2. Pleasant Valley quadrant- area which lies between Plass Rd. and the Creek.
3. Salt Point quadrant- large area off Creek Rd. This area has been subdivided into three on the map: 3a, 3b, and 3c.
4. Salt Point quadrant- area northwest of Salt Point off Clinton Hollow Road.
5. Salt Point quadrant- area north of Little Wappinger Creek off Centre Road
6. Millbrook quadrant- area contiguous to the East Branch tributary to Wappinger Creek
7. Pine Plains quadrant- area off Mountain Rd. opposite Stissing in the Stanford region

Several of these geographic areas have a significan t soils component with a relatively high erosion component. Sediment diversion structures might well be utilized if placed to divert sediment from these soils:
Area 1: HvD-Hudson and Vergennes soils- characterized by slopes of 15-30% and soil erosion coefficients of .37-.49.
Area 2: DwD- Dutchess-Cardigan complex soils- characterized by slopes of 15-30% and soil erosion coefficients of .28-.37.
Area 3a: DwC- Dutchess Cardigan complex. (See description under Area 2) and Fcd- Farmington-Galway soils characterized by slopes of 15-30% and a soil erosion coefficien of .32.
Area 4: NwD- Nassau-Cardigan complex characterized by a 15-30% slope and soil erosion coefficients of .20-.37.

ii. Sediment detention- Sediments can be detained within the Creek by the development of sedimentation basins. If designed correctly, the larger silt particles should settle out in the basins prior to reaching Wappinger Lake. The size and shape of the basins is dependent upon soil particle size, water velocity and flow. The most effective placement of the basins is in areas where the water velocity is already decreased within the system. Water velocity will have to be gaged throughout Wappinger Creek and tributaries to determine optimum placement. Sedimentation basins are part of a long-term management plan in that upkeep in the form of periodic silt removal from the basins is essential.
Cost: Dependent upon quantity of soil removal needed for basin construction. Unit cost of soil removal is approximately $10/cubic yard (Alpern. pers.com.).

Nutrient loading will be somewhat reduced through sediment reduction as much of the nutrient limiting factor, phosphorus, enters the lake as adhered molecules to soil particles. Development of a phosphorus budget would enable identification of the greatest input sources of phosphorus to the system. Because of the size and land use of the watershed it is logical to assume, at this point, that the main phosphorus source is agricultural practices. Agricultural runoff can be handled either through diversion or control.

i. Runoff diversion- diversion of stormwater runoff to either existing wetlands (common throughout the system) or through the construction of wetlands at major input areas. Recent use of this technique in Minnesota (Weidenbacher and Willenburg, 1986) resulted in a 48% decrease in Kjeldahl nitrogen, a 62% reduction in total phosphorus, and a 69% reduction in orthophosphates.

ii. Runoff control- The following are modifications in agricultural practices which reduce runoff and therefore reduce nutrient loading: conservation tillage, contour farming, contour stripcropping, integrated pest management, terracing, and animal waste and fertilizer management.

VI. Conclusion

Enduring improvement of the recreational uses and water quality of Wappinger Lake requires a comprehensive long term approach to water management. This report attempts to offer limited guidance in the methods available, with the suggestion they be carried out through the assistance of the EPA Clean Lakes program.

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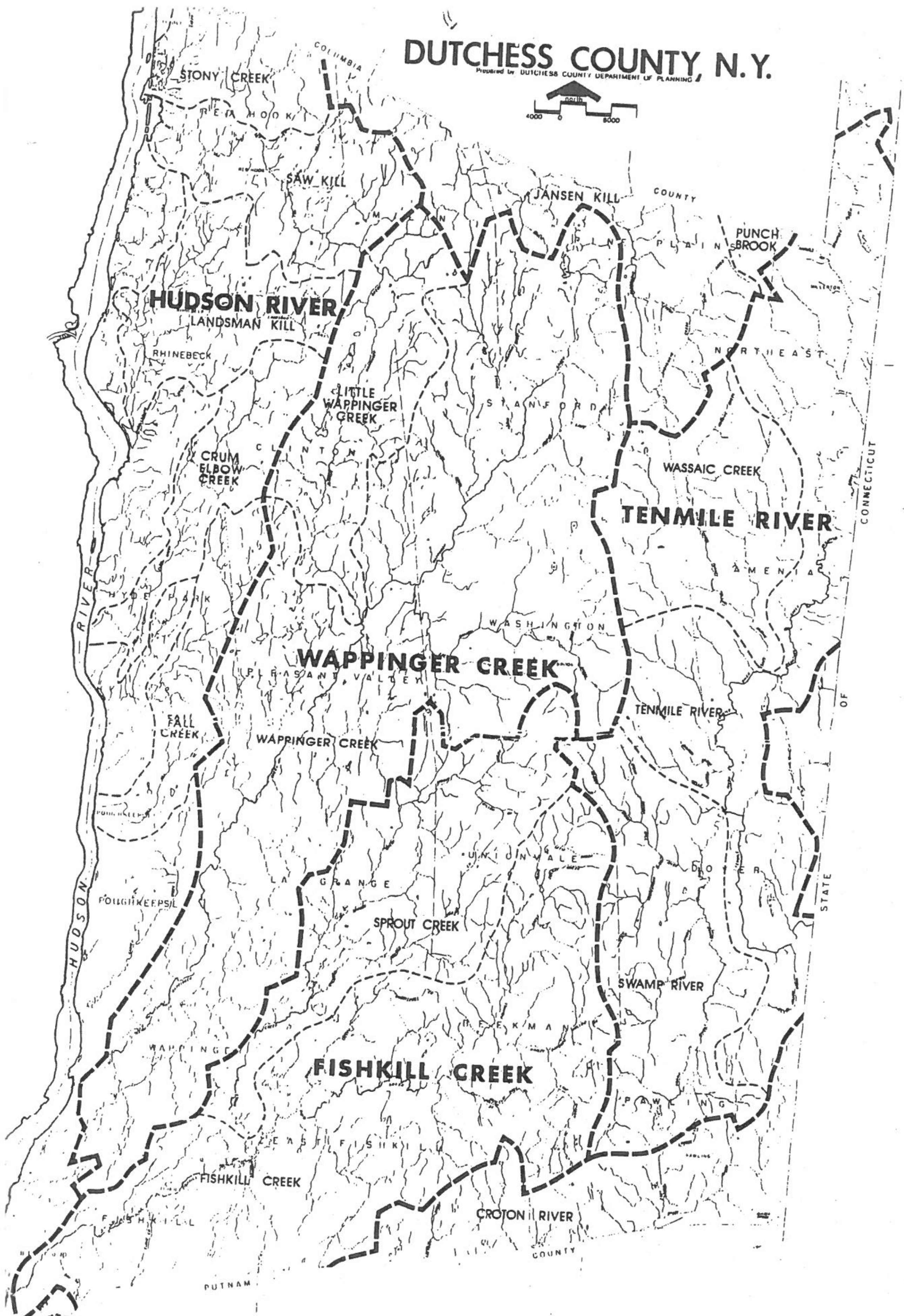
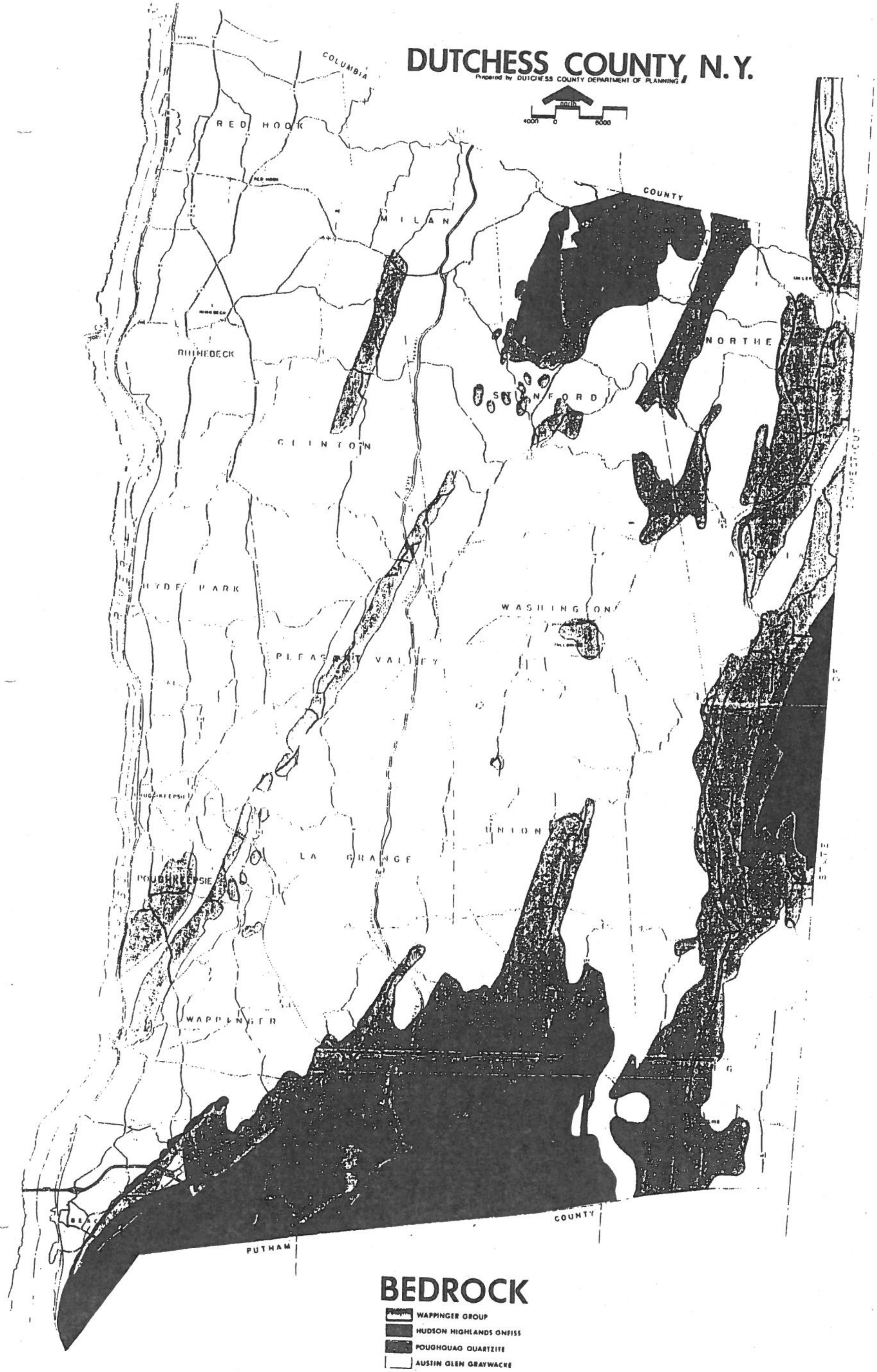
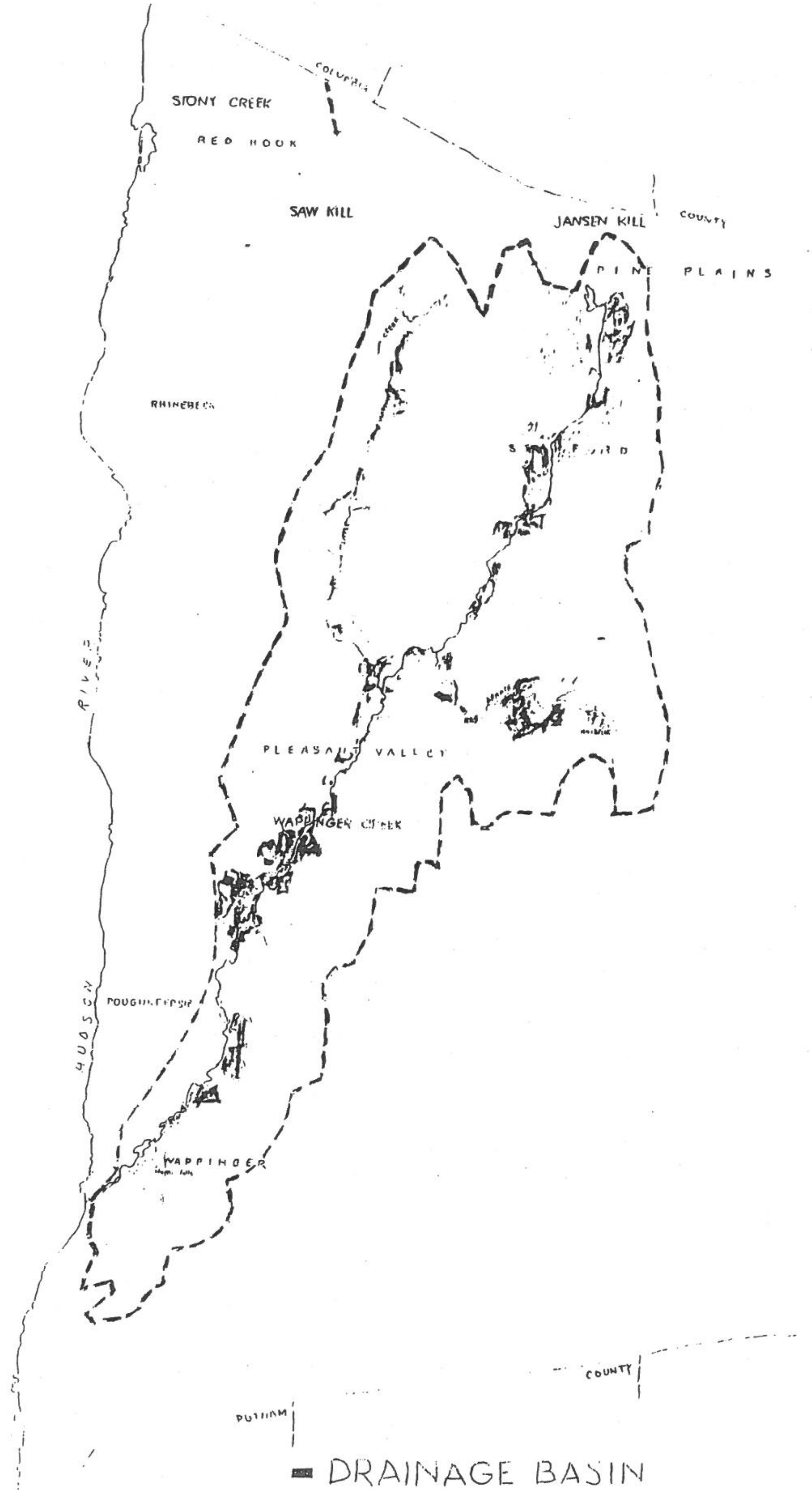


DRAINAGE BASINS

PRIMARY BASIN
SECONDARY BASIN

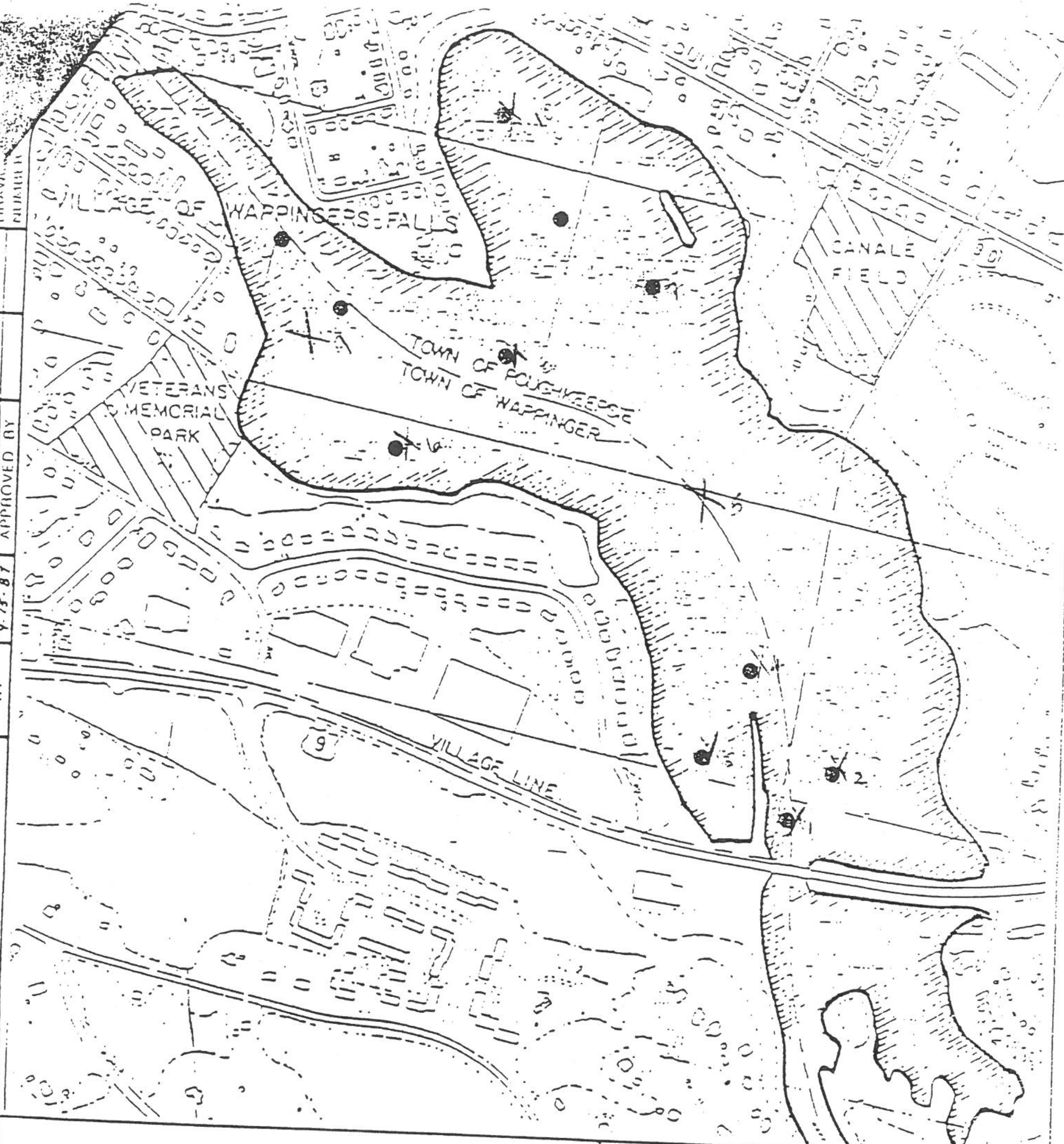
FIGURE 1


DUTCHESS COUNTY, N.Y.
Prepared by DUTCHESS COUNTY DEPARTMENT OF PLANNING
north
4000 0 8000
COLUMBIA
COUNTY
RED HOOK
MILAN
RHINEBECK
STANFORD
NORTHE
CLINTON
HYDE PARK
WASHINGTON
PLEASANT VALLEY
UNION
LA GRANGE
POUGHKEEPSIE
WAPPINGER
PUTNAM
COUNTY
BEDROCK
WAPPINGER GROUP
HUDSON HIGHLANDS GNEISS
POUGHQUAG QUARTZITE
AUSTIN GLEN GRAYWACKE



STONY CREEK
RED HOOK
SAW KILL
JANSEN KILL
COUNTY
PINE PLAINS
RHINEBECK
HUDSON RIVER
PLEASANT VALLEY
WAPPINGER CREEK
WAPPINGER
COUNTY
PUTNAM
DRAINAGE BASIN

FIGURE 3



LEGEND:

● SAMPLING LOCATION (DOT)

X ACOE SAMPLING LOCATION

0 500'

WAPPINGER LAKE
DREDGE ANALYSIS
SEDIMENT SAMPLING LOCATIONS

Do Not Scale This Drawing